INSTRUCTION MANUAL

PSK DEMOD

EMR MODEL 2726-02
PCM SIGNAL CONDITIONER
AND MODEL 2727
SELECTOR MODULES
(REVISION C)

1.024MHz

EMR TELEMETRY

BOX 3041 • SARASOTA, FLORIDA 33578

4/26/72 Replaced Q3 on AC PS board (no -18V)

ORDERING INFORMATION

Model 2727 Selector Module

a b c d e *

Specify "Model 2727-xx-xxxxxxx-x-x-xx-(xxxxxxx) Selector Module"

a. Input code and bit-rate range:
- 01 = NRZC (100 to 2,000,000 bps)
- 02 = NRZM (100 to 2,000,000 bps)
- 03 = NRZS (100 to 2,000,000 bps)
- 04 = SØC (100 to 1,000,000 bps)
- 05 = SØM (100 to 1,000,000 bps)
- 06 = SØS (100 to 1,000,000 bps)
- 07 = RZ (100 to 1,000,000 bps)
- 08 = Bipolar (100 to 2,000,000 bps)
- 09 = PSK (100 to 2,000,000 Hz) no BPIF
- 10 = PSK (100 to 2,000,000 Hz) with BPIF

b. Bit rate to three significant digits for bit rates from 100 to 2,000,000 bps or PSK carrier frequency from 100 to 2,000,000 Hz (0000100, 0250000, 1000000, etc.).

c. Capture and tracking range (1 = 1%; 2 = 3%; 3 = 10%). (3% is recommended for general use.)

d. Loop filter width (1 = 0.3%; 2 = 1%; 3 = 3%). (1% is recommended for general use.)

e. Panel paint and lettering codes (same as 2726 PCM Signal Conditioner).

*. (For 2727-10 only.) Bandpass input filter half-bandwidth in Hz from center frequency to -3 db point to 3 significant digits. Maximum width is ±30% and minimum width is ±1% of the carrier rate. The recommended filter half-bandwidth in Hz is equal to the maximum bit rate in bits per second to be passed. Example: for 64 kbps modulation, use a filter half-bandwidth of 64,000 Hz (0064000).

E - 54020 - 0514 - 000000

2726-02 S/N 139
2727-10 S/N 191

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INSTRUCTION MANUAL

PSK DEMOD

EMR MODEL 2726-02
PCM SIGNAL CONDITIONER
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SELECTOR MODULES
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1.024MHz

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EMR TELEMETRY

BOX 3041 • SARASOTA, FLORIDA 33578

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PRINTED MAY, 1970

2727-10-1024000-Z-2-1
WITH 10.24 KHz BPIF

NOTICE

IN THE EVENT THIS EQUIPMENT MUST BE RETURNED TO EMR FOR ANY REASON, SPECIAL CARE MUST BE EXERCISED IN PACKAGING FOR SHIPMENT. CARTON WITHIN A CARTON TYPE PACKING, WITH FOAM SUPPORT AND SEPARATORS IS RECOMMENDED TO PREVENT SHIPPING DAMAGE. SHOULD ANY INFORMATION BE REQUIRED REGARDING PACKAGING OF EMR EQUIPMENT, CONTACT EMR-TELEMETRY, SARASOTA, FLORIDA.

January 1971

MANUAL CHANGE NOTICE #1

EMR Model 2726-02 PCM Signal Conditioner

EFFECTIVITY: Regulator Card (6332), serial numbers 68 and up.

DESCRIPTION: On the regulator card, resistors R5, R12, R17, and R24 are changed from 909 ohms to 604 ohms. Changes to the manual are as follows --

a. In Figure 5-7, change value of R5, R12, R17, and R42 from 909 ohms to 604 ohms.

b. In Table 6-4 (regulator parts list), make changes shown below:

Was/Now	Item No.	Qty. Req'd.	Description	Drawing or Spec No.
Was	R5	1	Resistor, 909 Ohms ±1%, 1/8W	625
Now	R5	1	Resistor, 604 Ohms ±1%, 1/8W	625
Was	R12	1	Resistor, 909 Ohms ±1%, 1/8W	625
Now	R12	1	Resistor, 604 Ohms ±1%, 1/8W	625
Was	R17	1	Resistor, 909 Ohms ±1%, 1/8W	625
Now	R17	1	Resistor, 604 Ohms ±1%, 1/8W	625
Was	R24	1	Resistor, 909 Ohms ±1%, 1/8W	625
Now	R24	1	Resistor, 604 Ohms ±1%, 1/8W	625

February 1971

MANUAL CHANGE NOTICE #2

EFFECTIVITY: Model 2726-02, serial number 1 and up.

DESCRIPTION:

1. On page 1-1, paragraph 1.1, change item (i) and add item (j) as follows:

   i. Model 2727-09 -- Plug-in unit for use in a phase-shift keyed (PSK) demodulator. Does not contain a bandpass input filter.

   → j. Model 2727-10 -- Same as 2727-09 except contains a bandpass input filter. 10.24KHz

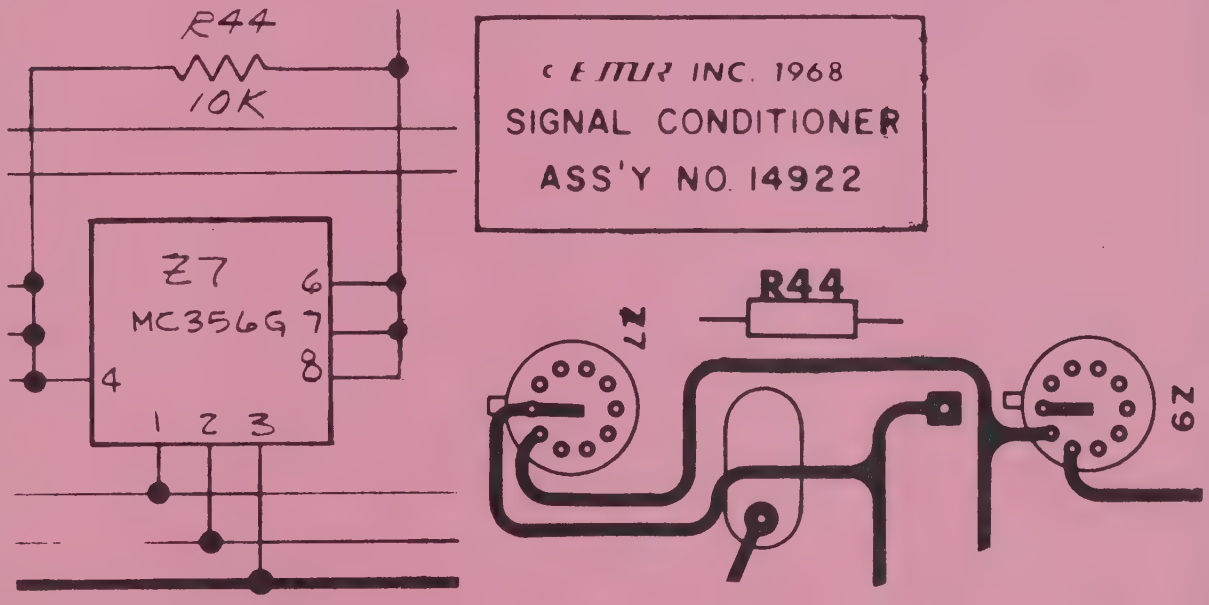
2. On page 5-3, paragraph 5.2.2.3, step (g), change A5R8 to A5R9 and change appropriate to approximate.

July 1971

MANUAL CHANGE NOTICE #3

EFFECTIVITY: EMR Model 2726-02 PCM Signal Conditioner, serial number 107 and up.

DESCRIPTION: On the Signal Conditioner Card A4, a feedback resistor is added from the Z7 output to the input. This resistor (R44) is shown and described as follows (ref. Figures 5-2 and 5-3, and Table 6-2) --



R44 -- RESISTOR, 10K ±5%, 1/4W;
MANUFACTURER NAME - Allen-Bradley;
MANUFACTURER PART NO. RC07GF103J.

July 1971

MANUAL CHANGE NOTICE #4

EFFECTIVITY: EMR Model 2726-02 PCM Signal Conditioner.

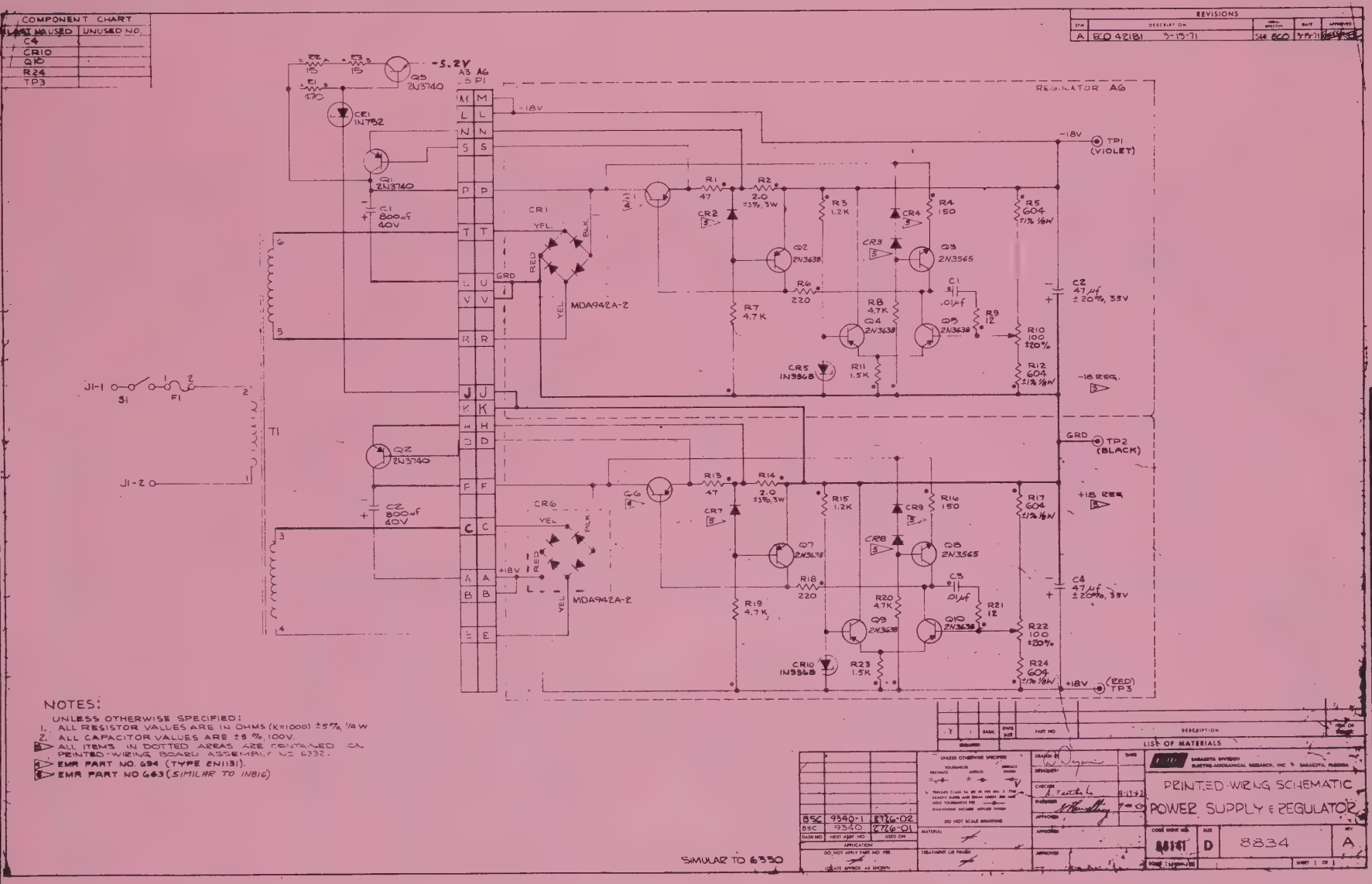
DESCRIPTION: The part number for integrated circuits Z13 and Z14 in the Signal Conditioner Card A4 Parts List (Table 6-2) is changed to SG42-03.

July 1971

MANUAL CHANGE NOTICE #5
(Sheet 1 of 4)

EFFECTIVITY: EMR Model 2726-02 PCM Signal Conditioner, serial number 68 and up.

DESCRIPTION: Component changes are made to improve operation of the Regulator Card A6. A revised schematic is shown on sheet 2 of this change notice which replaces Figure 5-7. The revised parts list is contained on sheet 3 of this change notice which replaces Table 6-4.



Regulator Card A6 Schematic Diagram

Circuit Symbol No.	Description	Manufacturer	
		Name	Part No.
A6	REGULATOR PRINTED-CIRCUIT CARD	EMR	6332 (Rev. L)
C1	CAPACITOR, .01 μF ±10%, 100V	EMR	809
C2	CAPACITOR, 47 μF ±10%, 35V	EMR	601
C3	Same as C1		
C4	Same as C2		
CR1	RECTIFIER, Bridge, Molded 1.5A	Motorola	MDA942A-2
CR2 thru CR4	DIODE, Stabistor, IF .64V	EMR	663
CR5	DIODE, Ref., 9V/7.5MA, .005%	Motorola	1N936B
CR6	Same as CR1		
CR7 thru CR9	Same as CR2		
CR10	Same as CR5		
Q1	TRANSISTOR, PNP, 50 MHz Amp-Osc-Sw	EMR	694
Q2	TRANSISTOR, PNP, 300 mA, 25V Sw., On	JEDEC	2N3638
Q3	TRANSISTOR	Fairchild	2N3565
Q4 & Q5	Same as Q2		
Q6	TRANSISTOR, PNP, 50 MHz Amp-Osc-Sw	EMR	694
Q7	Same as Q2		
Q8	Same as Q3		
Q9 & Q10	Same as Q2		
R1	RESISTOR, 47Ω ±5%, 1/4W	Allen-Bradley	RC07GF470J
R2	RESISTOR, 2.0Ω ±3%, 3W	Sage	1300S2-3
R3	RESISTOR, 1.2K ±5%, 1/4W	Allen-Bradley	RC07GF122J
R4	RESISTOR, 150Ω ±5%, 1/4W	Allen-Bradley	RC07GF151J
R5	RESISTOR, 604Ω ±1%, 1/8W	EMR	625
R6	RESISTOR, 220Ω ±5%, 1/4W	Allen-Bradley	RC07GF221J
R7 & R8	RESISTOR, 4.7K ±5%, 1/4W	Allen-Bradley	RC07GF472J
R9	RESISTOR, 12Ω ±5%, 1/4W	Allen-Bradley	RC07GF120J
R10	POTENTIOMETER, 100Ω ±20%, 1/4W, 1T	Clarostat	63M5
R11	RESISTOR, 1.5K ±5%, 1/4W	Allen-Bradley	RC07GF152J
R12	Same as R5		
R13	Same as R1		
R14	Same as R2		
R15	Same as R3		
R16	Same as R4		
R17	Same as R5		
R18	Same as R6		
R19	Same as R7		

MANUAL CHANGE NOTICE #5
(Sheet 4 of 4)

Circuit Symbol No.	Description	Manufacturer	
		Name	Part No.
R20	Same as R8		
R21	Same as R9		
R22	Same as R10		
R23	Same as R11		
R24	Same as R5		
	JACK, Test, Black	E.F. Johnson	105-853
	JACK, Test, Violet	E.F. Johnson	105-862
	JACK, Test, Red	E.F. Johnson	105-852

July 1971

MANUAL CHANGE NOTICE #6

EFFECTIVITY: Models 2727-02 and -03 NRZ-M/NRZ-S Selector Modules, serial number 154 and up.

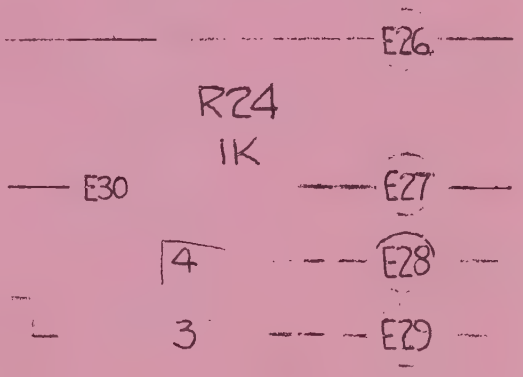
DESCRIPTION: A resistor is added to the printed-circuit card. This resistor is identified as follows --

R24 -- RESISTOR, 1K ±5%, 1/4W;
MANUFACTURER NAME - Allen-Bradley;
MANUFACTURER PART NO. RC07GF102J.

CARD LOCATION

(Ref. Figure 5-11)

CIRCUIT LOCATION



(Ref. Figure 5-12)

EMR MODEL 2726-02
AND
EMR MODEL 2727

LIST OF EFFECTIVE PAGES

Dates of issue for basic and revisions are:

Basic	October, 1968
Revision A	March, 1969
Revision B	February, 1970
Revision C	May, 1970

Total number of pages in this manual is 84 consisting of the following:

Page No.	Rev. Letter
*Title	C
i thru vi	Basic
1-1 thru 1-4	Basic
2-1 thru 2-6	Basic
*2-7	C
3-1 and 3-2	Basic
3-3	A
3-4 thru 3-6	Basic
4-1 thru 4-3	Basic
4-4	B
4-5 thru 4-21	Basic
5-1 thru 5-16	Basic
5-17	B
5-18	A
5-19 thru 5-23	Basic
5-24	B
5-25 thru 5-29	Basic
6-1	Basic
6-2	A
6-3 thru 6-10	Basic

* The asterisk indicates pages that changed in the current revision.

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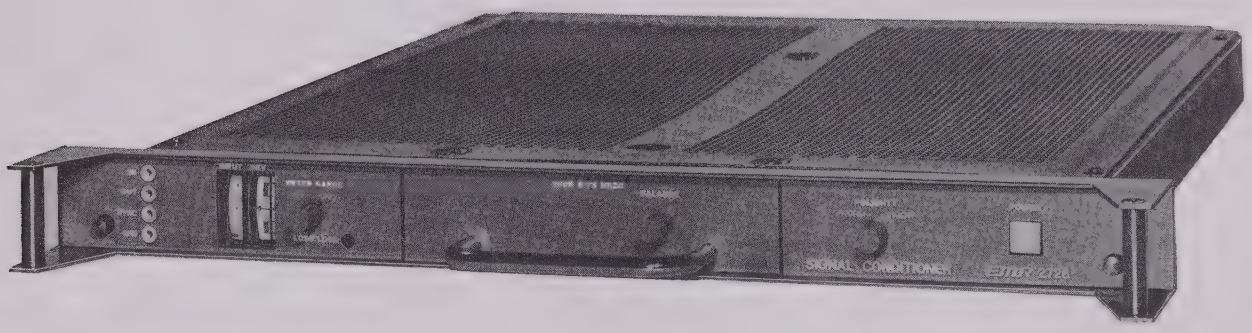


EMR Model 2726 PCM Signal Conditioner and Model 2727 Selector Module

SECTION 1

GENERAL DESCRIPTION

1.1 INTRODUCTION

This manual contains information describing the EMR Model 2726-02 PCM Signal Conditioner and Model 2727 Selector Modules. Included in this information is a functional and physical description, specifications, installation and operation, theory of operation, maintenance, and replaceable parts list.

The signal conditioner, including plug-in-type selector module, is a precision solid-state instrument designed for use in a PCM data complex or checkout system. The overall signal conditioner is comprised of a Model 2726-02 PCM Signal Conditioner and a plug-in-type Model 2727 Selector Module. Several selector modules are available providing signal conditioning for various types of PCM codes. Selector module types and PCM code identification are as follows:

a. Model 2727-01 --Plug-in unit for use with a serial nonreturn-to-zero type C (NRZC) PCM input.

b. Model 2727-02 --Plug-in unit for use with a serial nonreturn-to-zero type M (NRZM) PCM input.

c. Model 2727-03 --Plug-in unit for use with a serial nonreturn-to-zero type S (NRZS) PCM input.

d. Model 2727-04 --Plug-in unit for use with a serial split-phase type C (SØC) PCM input.

e. Model 2727-05 --Plug-in unit for use with a serial split-phase type M (SØM) PCM input.

f. Model 2727-06 --Plug-in unit for use with a serial split-phase type S (SØS) PCM input.

g. Model 2727-07 --Plug-in unit for use with a serial return-to-zero (RZ) PCM input.

h. Model 2727-08 --Plug-in unit for use with a serial bipolar PCM input.

i. Model 2727-09 --Plug-in unit for use in a phase-shift-keyed (PSK) demodulator.

Included in this manual are descriptions of the signal conditioner and the NRZC, NRZM, NRZS, and RZ selector modules. When a split-phase, bipolar or PSK type of selector module is supplied, a description of the particular selector module is provided in the form of an appendix to this manual.

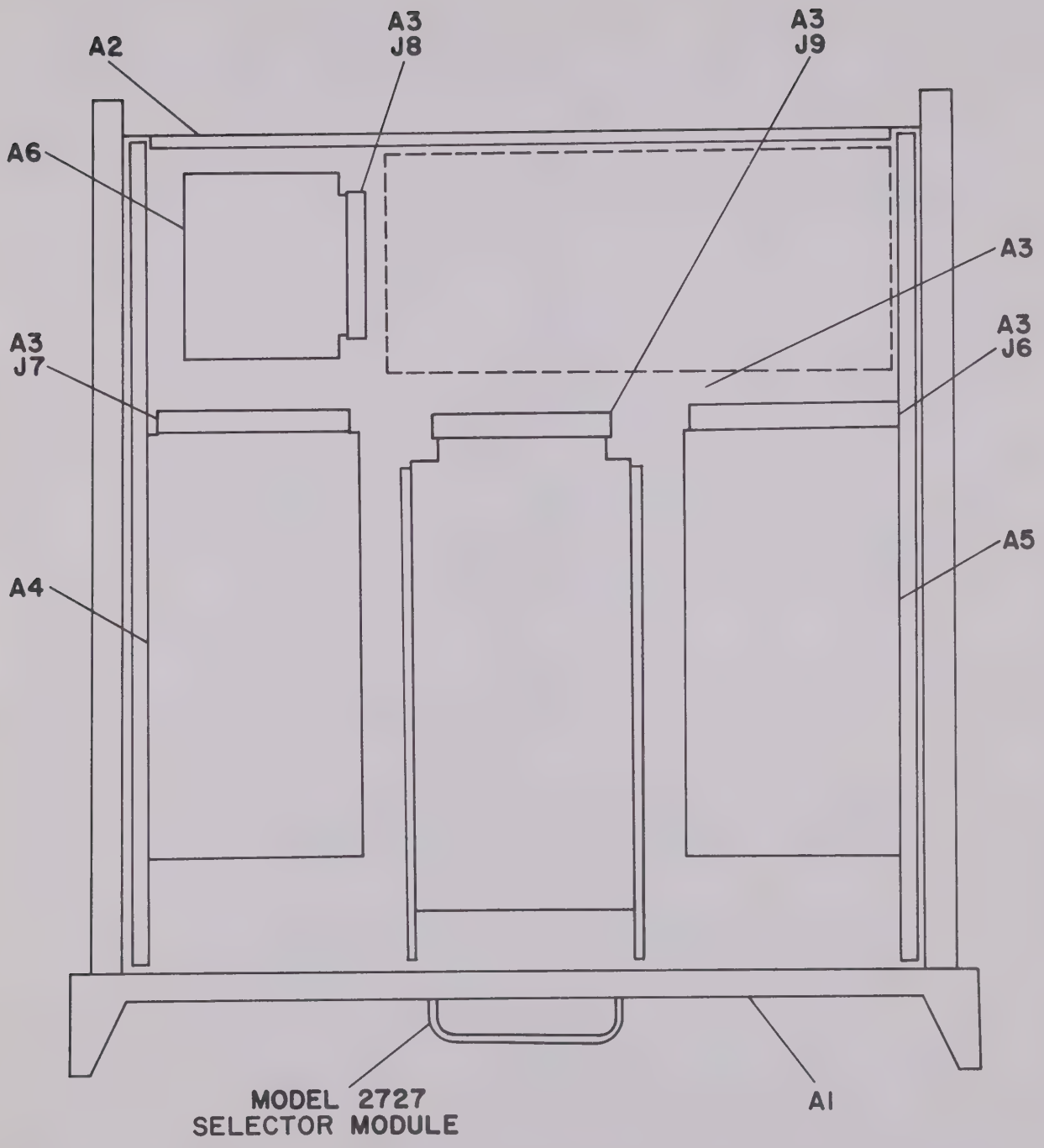
1.2 FUNCTIONAL DESCRIPTION

The signal conditioner accepts a serial pulse-code-modulated (PCM) input from a receiver, magnetic tape recorder, or signal simulator; conditions the input PCM signal, and provides serial PCM data and bit-synchronized timing outputs suitable for processing in a PCM decommutator or recording on a magnetic-tape recorder. Input bit frequencies between 100 bits and two megabits (one megabit for RZ code) are accommodated by interchangeable selector modules. The PCM input code (NRZC, NRZM, NRZS, and RZ) is also determined by the selector module. For any of the PCM input codes, the signal conditioner generates an equivalent NRZC serial PCM signal output and two bit-timing outputs marking each bit period of the serial PCM data. These outputs are available at front-panel test jacks and rear-panel connectors.

An internal power supply operates from an AC power input to generate all voltages necessary for operation of the signal conditioner.

1.3 PHYSICAL DESCRIPTION

The signal conditioner, including selector module, is a self-contained unit, 22 inches in overall depth, designed for mounting in a standard 19-inch equipment rack or portable instrument case. This unit is 1-3/4 inches high and occupies 19 inches of panel width in the mounting equipment. The major subassemblies of the signal conditioner are illustrated in Figure 1-1 and described in Table 1-1.



TOP VIEW

Figure 1-1. Model 2726 PCM Signal Conditioner Assembly Diagram

Table 1-1. Model 2726 PCM Signal Conditioner, List of Major Subassemblies (Ref. Figure 1-1)

REF. DESIG.	NAME	FUNCTION
A1	FRONT PANEL	Contains controls, indicators, and monitor jacks used in the operation of the signal conditioner. A description of the front-panel components is contained in Section 3, paragraph 3.2, Operation.
A2	REAR PANEL	Contains connectors for termination of all wiring between the signal conditioner and peripheral equipment. A description of the rear-panel connectors and external connections is contained in Section 3, paragraph 3.1, Installation.
A3	MAIN CHASSIS	Contains power-supply components, mating connectors for all printed-circuit cards and selector module, and interconnection wiring between subassemblies of the signal conditioner.
A4	Signal-Conditioner Printed-Circuit Card	Contains components for the conditioning of the PCM input, and PCM and bit timing outputs.
A5	Synchronizer Printed-Circuit Card	Contains components for the generation and synchronization of bit timing outputs.
A6	Regulator Printed-Circuit Card	Provides regulated DC voltages for operation of the signal-conditioner circuits.
	Model 2727 Selector Module	This unit contains a front panel (A1), printed-circuit card (A2), and rear connector (A3J1). Components of this unit select the PCM input code, loop width, tracking range, and bit rate of the signal conditioner. Front-panel nomenclature provides the PCM input code and operating bit-rate identification.

SECTION 2

SPECIFICATIONS

2.1 GENERAL

This section contains the electrical, mechanical, and environmental specifications for the Model 2726 PCM Signal Conditioner and Model 2727 NRZC, NRZM, NRZS, and RZ Selector Modules. Tables 2-1 and 2-2 provide part number identification for the 2726 and 2727.

2.2 ELECTRICAL SPECIFICATIONS

2.2.1 Inputs

a. Input Signals: Accepts serial PCM data of the following types--NRZC, NRZM, NRZS, and RZ (see Figure 2-1 for a description of the PCM codes). The codes are selected by Model 2727 Selector Modules. (Refer to Table 2-2 for a selector module PCM code identification.)

b. Input Level: Accepts a PCM input signal of any magnitude from 0.5 volt to 30 volts peak-to-peak. Two peak-to-peak input voltage ranges are as follows--

   1. 0.5 volt to 10 volts.

   2. 1.5 volts to 30 volts.

c. Input DC Offset: A DC offset of any magnitude up to ±100 volts in the input signal shall not degrade signal-conditioner operation.

d. Input AC Offset: Amplitude of up to 100% peak-to-peak signal level; frequency of up to 0.1% of nominal bit rate; minimum transition density of 50%.

e. Input Polarity: Input polarity, normal or inverted, is selected by front-panel polarity switch.

f. Input Impedance: Equal to or greater than 100K ohms shunted by a maximum capacitance of 150 Pf.

g. Input Configuration: Single-ended, referenced to signal ground.

h. Input Bit-Rate Range: Accepts PCM data operating in the range of 100 bits to 2 megabits for all NRZ PCM input codes and up to 1 megabit for RZ PCM code. The bit rate is selected by Model 2727 Selector Modules. (Refer to Table 2-2 for selector module bit-rate identification.)

i. Input Filter: Optimum constant-delay filter is provided in the Model 2727 Selector Module for each type of PCM input code and bit rate.

2.2.2 Synchronization

a. Loop Filter Width: An analog phase-locked-loop tracking filter is provided to generate the bit-synchronization signal. Loop widths of 0.3%, 1%, or 3% are selected by Model 2727 Selector Modules. (Refer to Table 2-2 for selector module loop-width identification.)

b. Deviation Meter: A front-panel deviation meter is provided to indicate deviation of the input bit rate from the nominal bit-rate frequency.

c. Capture and Tracking Range: ±1%, ±3%, or ±10% of nominal bit rate as selected by Model 2727 Selector Modules. (Refer to Table 2-2 for selector-module capture and tracking-range identification.)

d. Lock-Loss Indicator: A front-panel lamp provides a visual indication of a loss-of-lock condition.

e. Acquisition Time: The time required to achieve synchronization with the incoming signal is less than 200 bit periods for a capture range of ±3%, a phase-locked loop width of 1% and 50% bit-transition density.

f. Transition Density: Synchronization is maintained with transition densities as low as one transition in 64 bits with a loop width of 0.3%. After the 64-bit period, the phase error will not exceed ±50% of a bit period.

g. Input Bit Jitter: Synchronization is maintained in the presence of noncumulative input bit jitter providing a bit displacement as great as ±20% of a bit period from the nominal position. Jitter rate not in excess of nominal bit rate.

2.2.3 Outputs

a. PCM Signal: Serial NRZC PCM output is available for all PCM input codes as described in paragraph 2.2.1, step a.

b. PCM Signal Levels: A ZERO at the output is characterized by a 0- to +0.45-volt level. A ONE is characterized by a +3- to +5-volt level.

c. Bit Timing: Two sync outputs, 0° and 90°, are provided at the NRZC PCM bit rate. (See Figure 2-1 for sync output identification.) These outputs are positive-going signals generated synchronously with the PCM signal. The levels for the bit-timing outputs are as follows--0 volt to +0.45 volt and +3 volts to +5 volts. The pulse duration for each output is equal to 1/2 of a bit period.

d. Transition Time: The rise and fall times of all outputs are equal to or less than 0.1 microsecond.

e. Output Impedance: Less than 50 ohms.

f. Output Current: At a ONE level (4.5 volts), 1.2 milliamperes maximum. At a ZERO level (0 volt), 20 milliamperes from the external load.

2.2.4 Power Requirements

The self-contained power supply operates from a 120-volt RMS input ±10%, 47 to 440 Hz or 230-volt RMS input ±10%, 47 to 53 Hz, (See Table 2-1). Maximum power consumption from a 120-volt AC input is 20 watts.

2.3 MECHANICAL SPECIFICATIONS

a. Panel Height: 1-3/4 inches (4.45 Cm).

b. Panel Width: 19 inches (48.2 Cm).

c. Chassis Depth: 22 inches (55.9 Cm), excluding projections from front panel.

d. Weight:

1. Model 2726 (Including Slides)--Net, 18 pounds (8.17 Kg); shipping, 22 pounds (10 Kg).

2. Model 2727--Net, 2-1/2 pounds (1.14 Kg); shipping, 4 pounds (1.82 Kg).

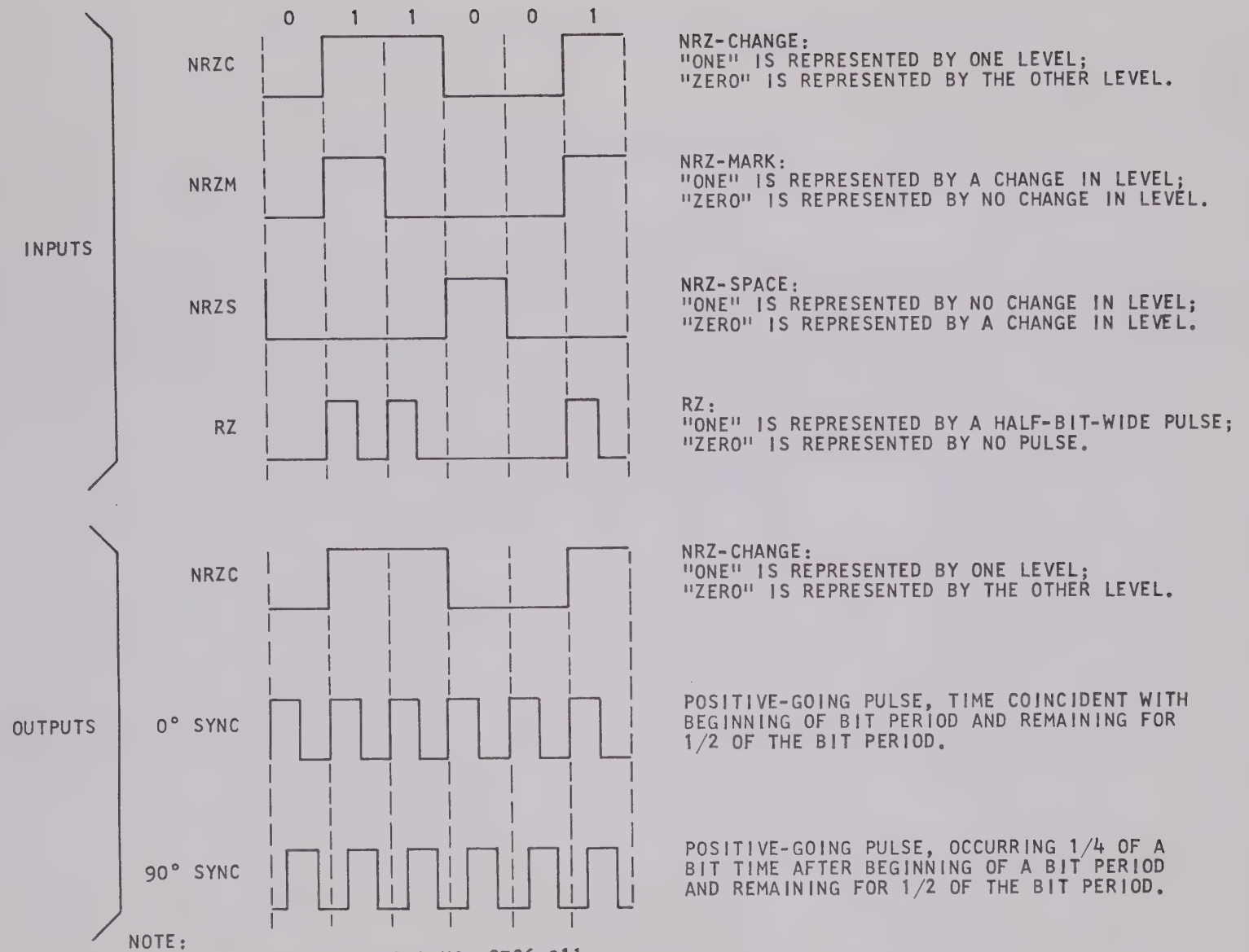
2.4 ENVIRONMENTAL SPECIFICATIONS

a. Operating Temperature Range: $0^{\circ}C$ to $+50^{\circ}C$ circulating air.

b. Storage Temperature Range: $-40^{\circ}C$ to $+85^{\circ}C$.

c. Altitude: Sea level to 10,000 feet.

d. Relative Humidity: 5% to 95%.


0 1 1 0 0 1
INPUTS
NRZC
NRZM
NRZS
RZ
NRZ-CHANGE:
"ONE" IS REPRESENTED BY ONE LEVEL;
"ZERO" IS REPRESENTED BY THE OTHER LEVEL.
NRZ-MARK:
"ONE" IS REPRESENTED BY A CHANGE IN LEVEL;
"ZERO" IS REPRESENTED BY NO CHANGE IN LEVEL.
NRZ-SPACE:
"ONE" IS REPRESENTED BY NO CHANGE IN LEVEL;
"ZERO" IS REPRESENTED BY A CHANGE IN LEVEL.
RZ:
"ONE" IS REPRESENTED BY A HALF-BIT-WIDE PULSE;
"ZERO" IS REPRESENTED BY NO PULSE.
OUTPUTS
NRZC
0° SYNC
90° SYNC
NRZ-CHANGE:
"ONE" IS REPRESENTED BY ONE LEVEL;
"ZERO" IS REPRESENTED BY THE OTHER LEVEL.
POSITIVE-GOING PULSE, TIME COINCIDENT WITH BEGINNING OF BIT PERIOD AND REMAINING FOR 1/2 OF THE BIT PERIOD.
POSITIVE-GOING PULSE, OCCURRING 1/4 OF A BIT TIME AFTER BEGINNING OF A BIT PERIOD AND REMAINING FOR 1/2 OF THE BIT PERIOD.

NOTE:
1. EMR DRAWING CONTROL NO. 2726-011.

Figure 2-1. PCM Input/Output Code-Comparison and Bit-Timing Diagram

Table 2-1. EMR 2726 PCM Signal Conditioner, Model Number Identification

EMR MODEL *2726 - XX - X - XX

This digit identifies the power required for operation. The code is as follows:	This digit identifies the design sequence. The code is as follows:	This digit identifies the slide mount configuration. The code is as follows:	These digits identify the paint color. The code is as follows:
0--120V RMS ±10%, 47 to 440 Hz	2--Standard	0--None	01--Light Green 00048W
8--230V RMS ±10%, 47 to 53 Hz		1--Non-tilting, non-retractable Chassis Trak	02--Dark Green 00049W
			04--Gray 26492B
			99--Special Paint

* This number is stamped on the nameplate.

Table 2-2. EMR Model 2727 Selector Module, Model Number Identification

EMR MODEL *2727-XX-XXXXXXX-X-X-XX-(XXXXXXX)

These digits identify the PCM input code. The code identification is as follows: 01 -- NRZC 02 -- NRZM 03 -- NRZS 04 -- SØC 05 -- SØM 06 -- SØS 07 -- RZ 08 -- Bipolar 09 -- PSK (no BPIF) 10 -- PSK (with BPIF)	These digits identify the PCM bit rates in bits-per-second from 100 to 2,000,000 BPS or PSK carrier frequency from 100 to 2,000,000 Hz. For example: 0000550 = 550 bits/sec. 0250000 = 250K bits/sec. 1000000 = 1M bits/sec.	This digit identifies the capture and tracking range. The code identification is as follows: 1 -- 1% 2 -- 3% 3 -- 10%	This digit identifies the loop filter width. The code is as follows: 1 -- 0.3% 2 -- 1% 3 -- 3%	These digits identify the paint color. The code is as follows: 01 -- Light Green 00048W 02 -- Dark Green 00049W 04 -- Gray 26492B 99 -- Special Paint

* This number is stamped on the nameplate.

1 (For 2727-10 only.) Band-pass input filter half-bandwidth in Hz from center frequency to -3 db point to 3 significant digits. Maximum width is ±30% and minimum width is ±1% of the carrier rate. The recommended filter half-bandwidth in Hz is equal to the maximum bit rate in bits-per-second to be passed. Example: for 64 KBPS modulation, use a filter half-bandwidth of 64,000 Hz (064000).

SECTION 3

INSTALLATION AND OPERATION

3.1 INSTALLATION

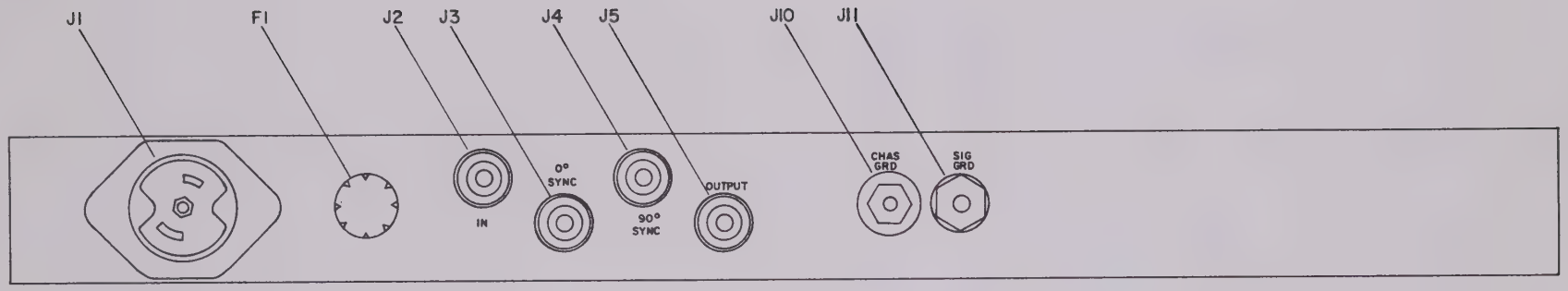
The signal conditioner, including selector module, is shipped completely assembled and ready for mounting. The unit should be inspected immediately on its arrival and notice given to EMR-Telemetry of any claim that the product does not conform with the terms of the order.

The signal conditioner is equipped with or without mounting slides, depending on the customer configuration requirements. Installation information for the available configurations is as follows:

a. Model 2726-XX-0--Mounting slides not supplied with the unit. Installation is completed in accordance with the customer application.

b. Model 2726-XX-1--Contains telescopic-type mounting slides for direct installation in a standard 19-inch equipment rack or portable instrument case. After unpacking the unit, remove the mounting slides from the signal conditioner and mount the slides to the internal frame of the mounting equipment. Mounting hardware for this installation is supplied with each unit. Insert the signal conditioner into the slides until the unit is firmly seated. Turn-to-lock fasteners on either side of the front panel secure the unit in the mounting location. The signal conditioner may be extended from the rack for servicing by loosening the front-panel turn-to-lock fasteners and pulling the unit straight out. Stop latches are provided on the front surfaces of both slides holding the unit at the maximum extension. At this point, the unit may be removed from the rack by depressing the stop latches and pulling the unit straight out.

After installing the signal conditioner in the mounting equipment, make all external electrical connections to connectors on the rear panel. The location of the rear-panel connectors is illustrated in Figure 3-1 and the type of connections to be terminated are described in Table 3-1.



NOTE: EMR DWG. CONT. NO. 2726-001.

Figure 3-1. Model 2726 Signal Conditioner, Location of Rear-Panel Connectors

Table 3-1. Function of Rear-Panel Connectors (Ref. Figure 3-1)

REF. NO.	NAME	DESIG-NATION	FUNCTION
J1	Power Plug	Hubbell Twist-lock	Primary power input to the signal conditioner power supply. Power cord, 8-feet, supplied with the unit.
J2	IN	BNC	Serial PCM data-input jack.
J3	0° SYNC	BNC	Bit-timing signal output at 0° phase shift from PCM data output.
J4	90° SYNC	BNC	Bit-timing signal output at 90° phase shift from PCM data output.
J5	OUTPUT	BNC	Serial PCM data-output jack.
J10	CHAS. GRD	Binding Post	Chassis ground
J11	SIG GRD	Binding Post	Signal ground.

3.2 OPERATION

3.2.1 Front-Panel Controls, Indicators, and Monitor Jacks

The signal conditioner is operated and monitored by front-panel controls, indicators, and monitor jacks. Each of the front-panel components is illustrated in Figure 3-2 and described functionally in Table 3-2.

3.2.2 Operating Procedure

a. Ascertain that the PCM input code and bit-rate frequency correspond to the parameters selected by the Model 2727 Selector Module. (The selector module input code and bit-rate frequency are identified on the front panel.)

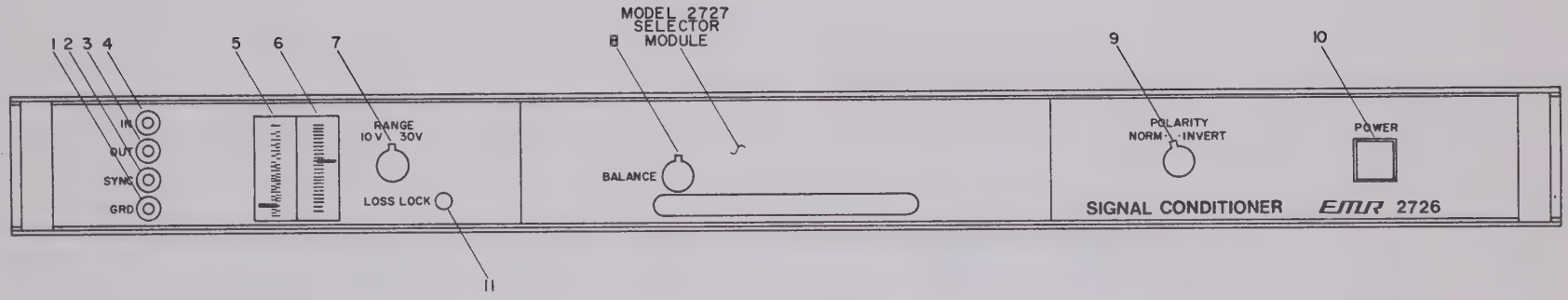
b. Position the front-panel RANGE switch, S3, to 10V or 30V as required by the magnitude of the PCM signal input. Use the 10V position for inputs between 0.5 volt and 8 volts peak-to-peak. Use the 30V position for inputs between 8 volts and 30 volts peak-to-peak.

c. Depress the front-panel POWER pushbutton switch, S1.

d. Position the front-panel POLARITY switch, S2, as required by the particular application.

e. Rotate the front-panel BALANCE control A1R1 (on Model 2727 Selector Module front panel) to center the DEV meter M1.

f. Observe that the LOSS LOCK indicator, DS1, is extinguished.



NOTE: EMR DWG. CONT. NO. 2726-002.

Figure 3-2. Model 2726 PCM Signal Conditioner, Front-Panel Controls, Indicators, and Monitor Jacks

Table 3-2. Function of Front-Panel Controls, Indicators, and Monitor Jacks (Ref. Figure 3-2)

REF. NO.	NAME	DESIG-NATION	FUNCTION
1	GRD	TP1	Signal ground test jack.
2	SYNC	TP2	Bit-timing output test jack, 0^{o} sync.
3	OUT	TP3	PCM data (NRZC) output test jack.
4	IN	TP4	Serial PCM input test jack.
5	INPUT meter	M2	Provides a visual display of serial PCM input magnitude.
6	DEV meter	M1	Provides a visual display of variations in the incoming serial PCM data bit-rate frequency from the nominal frequency.
7	RANGE switch	S3	Provides full-scale range switching of 10 volts and 30 volts for the INPUT meter, M2, and serial PCM input attenuation switching.
8	Model 2727 Selector Module BALANCE control	A1R1	Provides a means of adjusting voltage-controlled-oscillator frequency to correspond to frequency of incoming PCM data.
9	POLARITY switch	S2	Selects the polarity of the serial PCM data input.
10	POWER switch and indicator	S1	Pushbutton switch controls application of primary power to internal power supply. When power is applied, switch indicator illuminates.
11	LOSS LOCK indicator	DS1	Indicator illuminates when unit loses synchronization with the incoming serial PCM data.

SECTION 4

THEORY OF OPERATION

4.1 GENERAL

This section contains the functional theory of operation for the Model 2726 PCM Signal Conditioner and Model 2727 NRZC, NRZM, NRZS, and RZ Selector Modules. The theory discussion is presented at two levels, general and detailed. The general theory of operation is provided in paragraph 4.2 with reference to the simplified block diagram illustrated in Figure 4-1. The detailed theory of operation is provided in paragraph 4.3 with reference to the detailed block and logic diagrams in Figures 4-2, 4-3, and 4-4.

Many of the signal conditioner circuits utilize integrated-circuit modules. These modules contain digital logic gates, amplifier circuits, level shifting gates, and driver gates. A description of each type of module and the operation of the gates is provided in Figures 4-5 through 4-15.

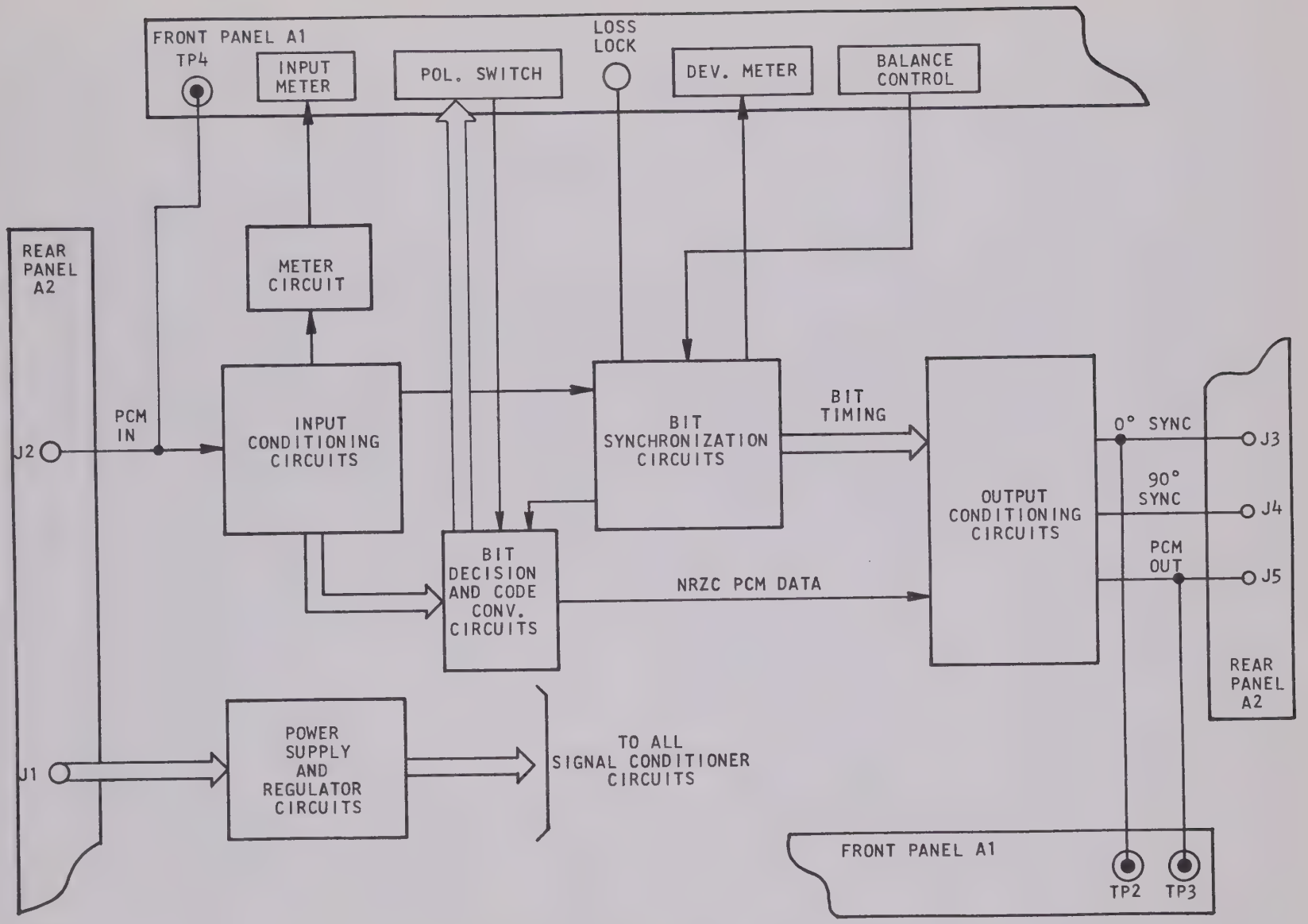
4.2 GENERAL THEORY OF OPERATION

The signal conditioner accepts a serial PCM input from a receiver, magnetic-tape recorder, or signal conditioner; conditions the PCM input signal, and provides serial PCM data and bit-synchronized timing outputs. The basic signal conditioner circuits performing these operations are shown in the simplified block diagram, Figure 4-1.

The PCM input signal, coded NRZC, NRZM, NRZS, or RZ, is applied through rear-panel connector J2 to the signal-conditioner input-conditioning circuits. These circuits filter the PCM input signal, removing the noise content, limit the peak-to-peak amplitude, and reconstruct the PCM signal providing square-sided serial PCM wavetrain outputs. These outputs are applied to the meter circuit, the bit-synchronization circuits, and the bit-decision and code-conversion circuits.

The meter circuit attenuates and rectifies the PCM signal providing an output to the front-panel INPUT meter. This meter displays a voltage indication proportional to the magnitude of the PCM input signal. There are two meter ranges, 10 volts and 30 volts, corresponding to the voltage ranges selected by the front-panel RANGE switch.

The bit-synchronization circuits utilize the reconstructed serial PCM wavetrain to generate bit-timing signals marking the bit periods of the PCM data bits. A voltage-controlled oscillator (VCO) operates at the nominal bit-rate frequency, selected by the signal-conditioner selector module, and generates the bit-timing signals. These signals are compared with the reconstructed PCM signal in a



NOTE:

1. EMR DRAWING CONTROL NO. 2726-003.

Figure 4-1. Model 2726 PCM Signal Conditioner, Simplified Block Diagram

phase detector to determine the phase difference, if any, between the nominal VCO frequency and the frequency of the PCM signal. Should any phase difference occur, a loop amplifier provides a compensation voltage proportional to the difference and deviates the VCO frequency an amount equal to the frequency error. The amount of deviation between the PCM bit frequency and the VCO frequency is displayed on a front-panel DEV meter.

If the phase error increases beyond the tracking range of the signal-conditioner VCO, the loss-of-lock circuitry recognizes the excessive phase error and generates a loss-lock signal. A loss-of-lock condition is observed by the illumination of the front-panel LOSS LOCK indicator.

Bit-timing signals from the bit-synchronization circuits gate the reconstructed serial PCM data from the input-conditioning circuits into a bit-decision circuit. This process aligns the serial PCM signal with the bit-timing signals. Complementary PCM outputs are applied to the front-panel POLARITY switch which selects the proper PCM phase, normal or inverted. The selected PCM signal is then applied directly to the output-conditioning circuits or to a code-conversion circuit, depending on the particular selector module. For NRZC and RZ selector modules, the bit-decision output is coded NRZC and, therefore, code conversion is unnecessary. However, for the NRZM and NRZS selector modules, the bit-decision output is applied to the code converter. The code converter converts the serial NRZM or NRZS PCM signal into a serial PCM signal coded NRZC.

The bit-timing and serial NRZC PCM signals are applied to the output-conditioning circuits. These circuits provide the necessary level shifting and buffering for the signal conditioner outputs.

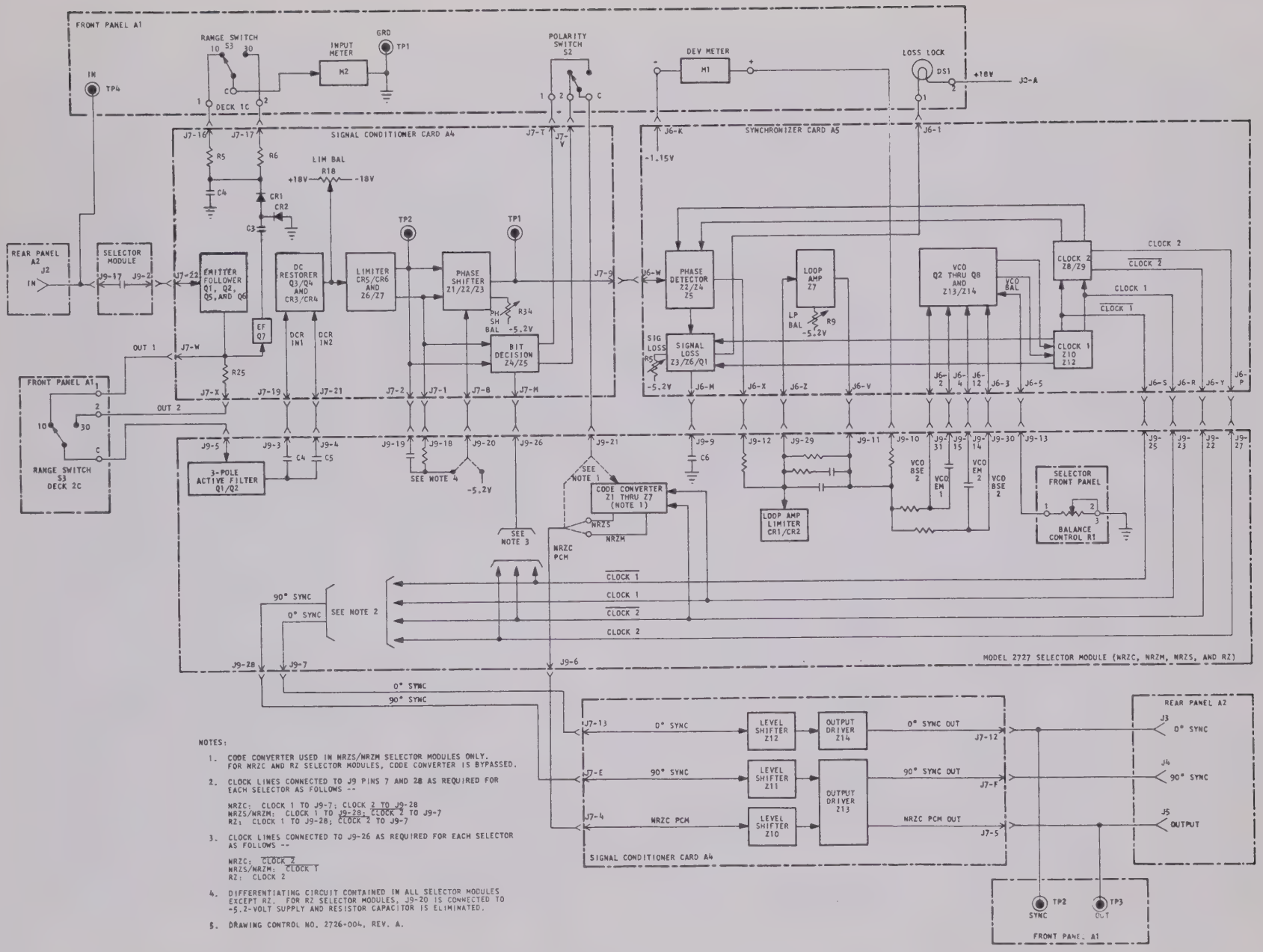
An internal power supply and regulator circuit operates from a primary power input to generate all necessary voltages for signal-conditioner operation.

4.3 DETAILED THEORY OF OPERATION

4.3.1 Input Conditioning Circuits (See Figure 4-2)

The serial PCM input signal, applied at rear-panel IN connector J2, is AC coupled through a capacitor in the selector module to a compound-connected emitter-follower stage (Q1, Q2, Q5, and Q6) on the signal conditioner card A4. The emitter-follower stage provides proper terminating impedance for the PCM input signal and increases the drive capability of the PCM signal for use in the signal-conditioner circuitry. Outputs from the emitter-follower stage are applied to a meter circuit and to the two positions (10V and 30V) of the front-panel RANGE switch S3.

The meter circuit consists of an emitter-follower, Q7; half-wave rectifier, CR1 and CR2; filter capacitor C4, and a front-panel INPUT meter, M2. The



NOTES:

1. CODE CONVERTER USED IN NRZS/NRZM SELECTOR MODULES ONLY. FOR NRZC AND RZ SELECTOR MODULES, CODE CONVERTER IS BYPASSED.
2. CLOCK LINES CONNECTED TO J9 PINS 7 AND 28 AS REQUIRED FOR EACH SELECTOR AS FOLLOWS --

   NRZC: CLOCK 1 TO J9-7; CLOCK 2 TO J9-28
   NRZS/NRZM: CLOCK 1 TO J9-28; CLOCK 2 TO J9-7
   RZ: CLOCK 1 TO J9-28; CLOCK 2 TO J9-7
3. CLOCK LINES CONNECTED TO J9-26 AS REQUIRED FOR EACH SELECTOR AS FOLLOWS --

   NRZC: $\overline{\text{CLOCK 2}}$
   NRZS/NRZM: $\overline{\text{CLOCK 1}}$
   RZ: CLOCK 2
4. DIFFERENTIATING CIRCUIT CONTAINED IN ALL SELECTOR MODULES EXCEPT RZ. FOR RZ SELECTOR MODULES, J9-20 IS CONNECTED TO -5.2-VOLT SUPPLY AND RESISTOR CAPACITOR IS ELIMINATED.
5. DRAWING CONTROL NO. 2726-004, REV. A.

Figure 4-2. Model 2726 PCM Signal Conditioner Detailed Block Diagram

PCM signal from the compound emitter-follower stages is coupled through Q7 to diodes CR1 and CR2. Diodes CR1 and CR2 rectify the signal supplying only the positive-going portions of the PCM signal across filter capacitor C4. The resultant voltage level is coupled through resistors R5 or R6, depending on the position of RANGE switch S3, to the INPUT meter M2.

The second output from the compound emitter-follower is applied through the 10V or 30V position of RANGE switch S3 to a 3-pole active low-pass filter contained on the selector module. Filter components are selected for each bit-rate frequency to remove the noise content contained in the PCM signal. The filter rolloff beyond the selected bit-rate frequency is typically 18 Db/octave. The filter output is separated into two signal paths and is AC coupled through capacitors C4 and C5 to the DC restorer circuit.

Components of the DC restorer circuit, contained on the signal conditioner card A4, establish a median operating level on which the filtered PCM signal is centered. This circuit is divided into two stages: A positive stage, Q3/CR3, and a negative stage, Q4/CR4, each operating on alternate half cycles of the PCM signal. The negative half-cycle of the PCM signal, applied to the positive stage, is clipped by diode CR3 and the positive half cycle is coupled through emitter-follower Q3. The negative stage, CR4 and Q4, operates in a similar manner to produce negative half-cycle outputs. Outputs from Q3 and Q4 are ORed by resistors R14 and R15 producing a composite PCM signal centered on a −1.15-volt level (set by limiter balance potentiometer R18). The resultant PCM signal is then applied to a wave-shaping limiter circuit.

The limiter circuit is a two-stage OR/NOR logic function consisting of clamp diodes CR5 and CR6, and integrated-circuit modules Z6 and Z7. Diodes CR5 and CR6 limit the peak-to-peak voltage swing at the Z7 input to approximately 2 volts, thus preventing an extreme saturation condition. The OR/NOR integrated-circuit modules reconstruct the PCM signal into complementary square-sided PCM wavetrain outputs. These outputs are applied to a differentiating network in the selector module (in all modules except the RZ selector module), the phase-shifting circuit, and the bit-decision circuit.

The differentiating network operates in conjunction with the phase-shifting circuit to generate an output operating at twice the PCM signal input frequency. This signal frequency corresponds to the bit-rate frequency for the NRZC, NRZM, or NRZS PCM input. For an RZ PCM input, the PCM input frequency is identical to the bit-rate frequency and, therefore, the frequency doubling is unnecessary. (Refer to the code-comparison diagram in Figure 2-1 for a comparison of PCM signal frequencies and corresponding bit-rate frequencies.)

To accomplish the frequency doubling in the NRZC, NRZM, or NRZS selector modules, the limiter outputs are differentiated delaying the PCM signal by 90°. The delayed signal is coupled through J9-20 and J7-8 to NOR-gate Z1 in the phase shifter. NOR-gate Z1 and OR/NOR-gate Z2 rectify and shape the differentiated signal providing complementary square-sided outputs to dual

NOR-gate Z3. The delayed outputs are compared with the limiter outputs in Z3, performing an exclusive OR function, and the resultant Z3 output is a square-sided PCM signal operating at the bit-rate frequency. This output is utilized by the bit-synchronization circuits in the generation of bit-timing signals.

4.3.2 Bit-Synchronization Circuits (See Figure 4-2)

The bit-synchronization circuits, contained on the synchronizer card, A5, are connected in a phase-locked-loop configuration in establishing bit synchronization with the PCM input. The phase-locked-loop method of synchronization is essentially that of a conventional null-seeking servo loop. Primary circuits of the phase-locked loop include a phase detector, loop amplifier and filter, and a voltage-controlled oscillator (VCO).

Initially, the VCO is free running at a frequency determined by components in the selector module. The VCO outputs trigger clock flip-flops Z8 and Z10 generating CLOCK 1 and CLOCK 2 outputs.

The CLOCK 2 outputs, delayed 90^{o} from the VCO frequency, are applied to dual NOR-gate Z5 in the phase detector. The reconstructed PCM output from the phase shifter in the input-conditioning circuits is coupled through phase-splitting OR/NOR module Z2 to a second input of each NOR gate in Z5. NOR-gate Z5 performs an exclusive OR function to determine the phase relationship between the signals. A phase difference of 90^{o} is recognized by the phase detector as zero phase error. If a zero-phase-error condition exists, the Z5 square-wave output is symmetrical with an equivalent DC component of zero. This output is filtered and amplified by loop amplifier module Z7 and feedback components in the selector module producing a zero-correction voltage for the VCO frequency-determining components.

Should the exclusive OR operation of Z5 recognize any deviation from the 90^{o} phase reference, the square-wave output of Z5 becomes nonsymmetrical either positive or negative. This signal is filtered and amplified by the loop filter and amplifier producing a correction voltage to the VCO frequency-determining components. This voltage changes the VCO frequency an amount equal to the deviation detected in the phase detector. The amount and direction of the correction voltage is displayed on front-panel DEV meter M1.

The selector module front-panel BALANCE control, R1, is used in conjunction with the DEV meter to adjust the VCO frequency.

If the frequency of the PCM signal input deviates beyond the tracking range of the VCO, the signal loss circuit, Z3, Z6, and Q1, recognizes this condition and generates a loss-lock output which illuminates a front-panel LOSS LOCK indicator. Module Z3 is a dual NOR gate which operates as a signal-loss phase detector in the same manner as the Z5 module. Inputs to the Z3 dual NOR gate

include both phases of the PCM signal from the phase-splitting gate Z2 and CLOCK 1 outputs from flip-flop Z10. Each clock pulse is compared with a PCM input to determine the phase relationship between the signals. If a zero phase-error condition exists, the Z3 output is a symmetrical square wave with an equivalent DC component of zero. However, if the phase error is either positive or negative, this results in an average DC component developed across resistor R3 and capacitor C6 in the selector module. This DC component is amplified in amplifier module Z6 producing an output level to transistor Q1. If the turn-on potential of Q1 is exceeded, Q1 supplies a ground-level loss-lock output illuminating the front-panel LOSS LOCK indicator.

4.3.3 Bit-Decision and Code-Conversion Circuits (See Figure 4-2)

The bit-decision and code-conversion circuits determine the polarity of bit information in the serial PCM signal input and convert the bit information into a serial PCM signal coded NRZC. The configuration and operation of these circuits vary depending on the type of selector module installed in the signal conditioner. Circuit configuration variations are noted on the detailed block diagram in Figure 4-2.

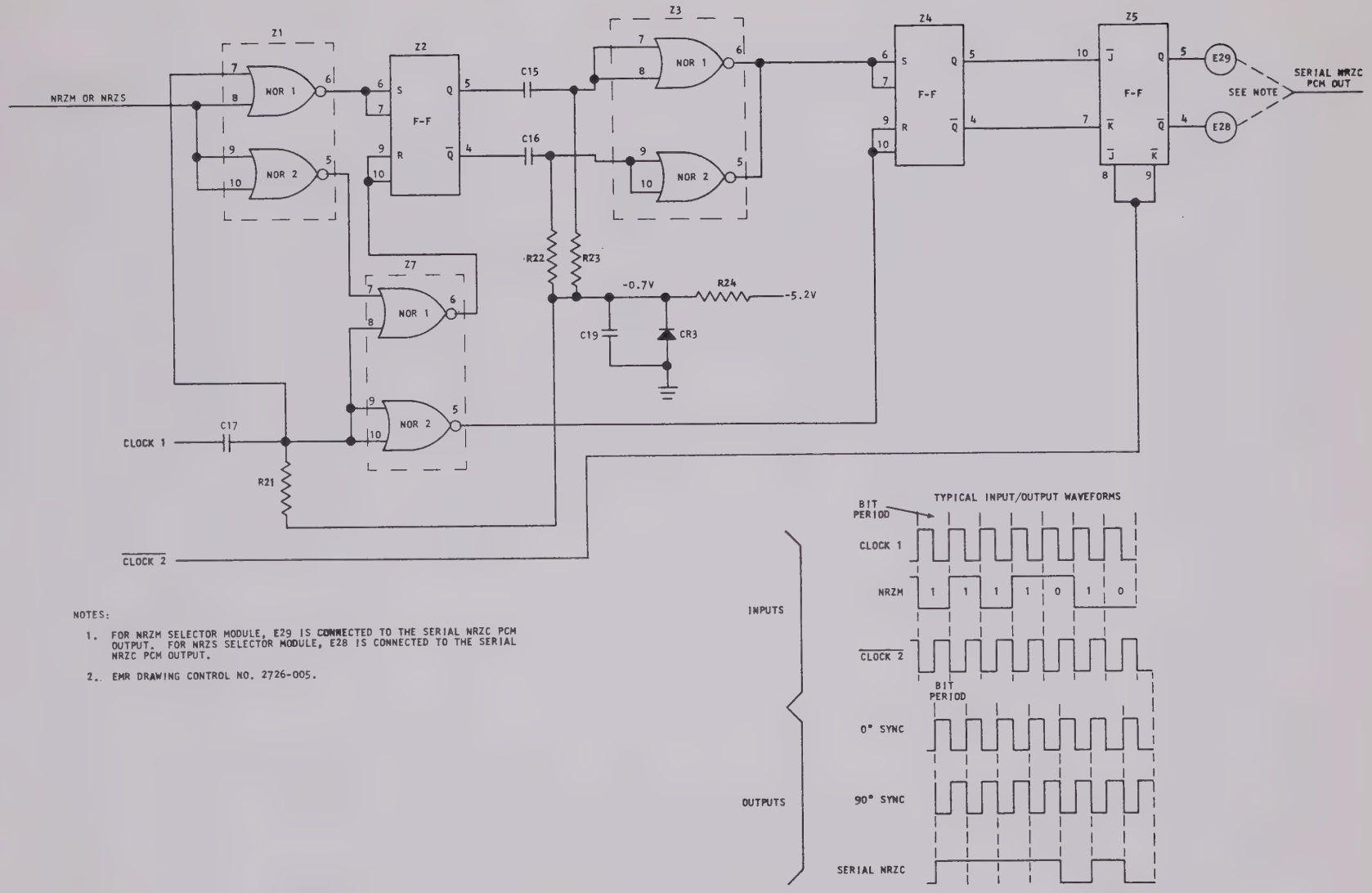
Serial PCM inputs to the bit-decision circuit are derived from the limiter circuit and the bit-timing (CLOCK) input is derived from the bit-synchronization circuit. The bit-timing input gates the PCM information bits through dual NOR-gate module Z5, thus aligning the PCM data with the bit-timing signal. The Z5 complementary outputs control the set and reset inputs of flip-flop Z4 which establishes the polarity of each data bit in the PCM signal. If the bit polarity indicates a data ONE, Z4 is set; if the bit polarity indicates a data ZERO, Z4 is reset.

Both phases of the bit-decision flip-flop outputs are routed to front-panel POLARITY switch S2. This switch is set to NORM or INVERT selecting the appropriate PCM signal phase.

Circuit configurations for processing of the PCM signal, selected at the POLARITY switch, differ depending on the PCM signal input code. For an NRZC or RZ coded PCM input, the NRZC and RZ selector modules couple the selected PCM signal directly to the output conditioning circuits. Code conversion for these PCM codes is accomplished in the bit-decision circuit. However, for an NRZM or NRZS coded PCM input, the NRZM or NRZS selector modules contain a code-converter circuit for the NRZM/NRZS to NRZC conversion.

The NRZM/NRZS to NRZC code-converter circuit and typical input/output waveforms for an NRZM PCM signal are shown in the logic diagram, Figure 4-3. Code conversion for an NRZS PCM input is identical in operation.

The serial PCM signal, coded NRZM or NRZS, is applied to one input of each NOR gate in the Z1 module. NOR-gate 2 inverts this signal supplying an inverted



NOTES:

1. FOR NRZM SELECTOR MODULE, E29 IS CONNECTED TO THE SERIAL NRZC PCM OUTPUT. FOR NRZS SELECTOR MODULE, E28 IS CONNECTED TO THE SERIAL NRZC PCM OUTPUT.
2. EMR DRAWING CONTROL NO. 2726-005.

Figure 4-3. NRZM and NRZS Selector Module Code-Converter Circuit, Logic Diagram

PCM signal to one input of NOR-gate 1 in the Z7 module. A second input to NOR-gate 1 of each module is a strobe pulse generated by differentiating the CLOCK 1 input. Each bit time, this strobe pulse is ANDed with the normal or inverted PCM in NOR-gates 1 of Z1 or Z7 to establish the PCM bit polarity. If the PCM bit is a logic ZERO level, NOR-gate 1 in Z1 applies a set (S) pulse to flip-flop Z3; if the PCM bit is a logic ONE level, NOR-gate 1 in Z7 applies a reset (R) pulse to flip-flop Z2. Thus, each time a PCM bit polarity change occurs, flip-flop Z2 changes state.

When a change in state occurs, the Z2 outputs are differentiated by C15/R23 and C16/R22 and rectified by diode CR3 supplying only the positive portions of the Z2 outputs to dual NOR-gate module Z3. The change of state pulses are inverted and ORed in Z3 and applied to the set input of flip-flop Z4. When in the set condition, the Z4 output (Q) is at a logic ONE level and the $\overline{\text{output}}$ ($\overline{Q}$) is at a logic ZERO level. A second input to flip-flop Z4 is a reset (R) pulse generated by NOR 2 in NOR-gate module Z7. This input is generated each bit time by the CLOCK 1 input resetting flip-flop Z4. However, a set pulse from Z3 overrides the reset when a change of state occurs in Z2.

The Z4 outputs are gated through flip-flop Z5 each bit time by the CLOCK 2 input. Either the Z5 Q or $\overline{Q}$ output is used as the serial NRZC output depending on the particular selector module.

Thus, for an NRZM PCM input, a logic ONE level is indicated by a change of state. The change of state results in a logic ONE level at the Z5 Q output. For an NRZS PCM input, a logic ZERO level is indicated by a change of state and the change of state results in a logic ZERO level at the Z5 $\overline{Q}$ output.

4.3.4 Output Conditioning Circuits (See Figure 4-2)

The output-conditioning circuits, contained on the signal-conditioner card A4, provide the necessary level shifting and buffering for the serial NRZC PCM output and bit-timing outputs.

These circuits include three level-shifting stages, Z10, Z11, and Z12, and three output driver stages, Z13 and Z14. One level-shifting stage and one output driver stage are used for each signal-conditioner output, PCM data, 0° sync, and 90° sync.

The level-shifter circuits change the logic levels from those used in the signal-conditioner circuits (logic ZERO = 1.7 volts and logic ONE = −0.7 volt) to the levels specified for signal-conditioner outputs. The output logic levels are as follows:

Logic ZERO--0 to +0.45 volt.

Logic ONE-- +3 to +5 volts.

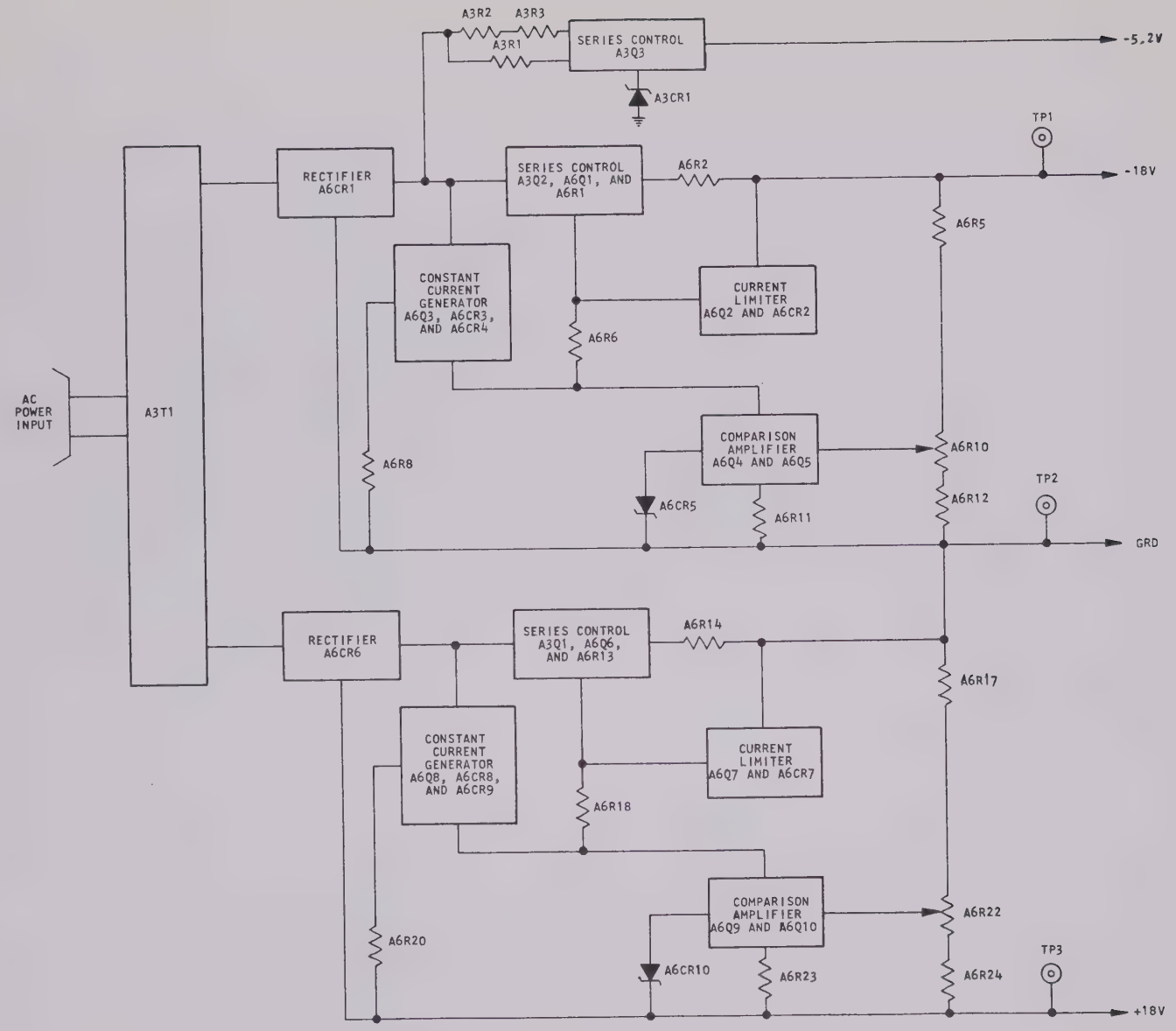
4.3.5 Power Supply and Regulator Circuits

The power supply and regulator circuits operate from a primary AC power input to generate the DC voltages necessary for signal-conditioner operation. These circuits are contained on the signal-conditioner main chassis, A3, and regulator card A6. The power supply and regulator circuits are illustrated in the block diagram, Figure 4-4.

As shown in Figure 4-4, the AC power input is applied to the primary winding of power supply transformer A3T1. Two secondary windings of A4T1 apply the step-down AC voltage to full-wave bridge rectifiers, A6CR1 and A6CR6. These rectifiers supply unregulated DC voltages to three regulator circuits: +18-volt regulator, −18-volt regulator, and −5.2-volt regulator. Regulation in the +18-volt and −18-volt regulators is accomplished by comparing a sample of the output potential with a voltage reference obtained from a zener diode. A differential comparison amplifier senses the magnitude and direction of a voltage difference from the reference and regulates the biasing of the series control.

Current supplied to the regulator output is limited by a current-limiting stage. This stage samples the amount of voltage developed across a series resistance and, if this voltage is sufficiently high, regulates the biasing of the series control. Once current limiting occurs, further increases of current are inhibited.

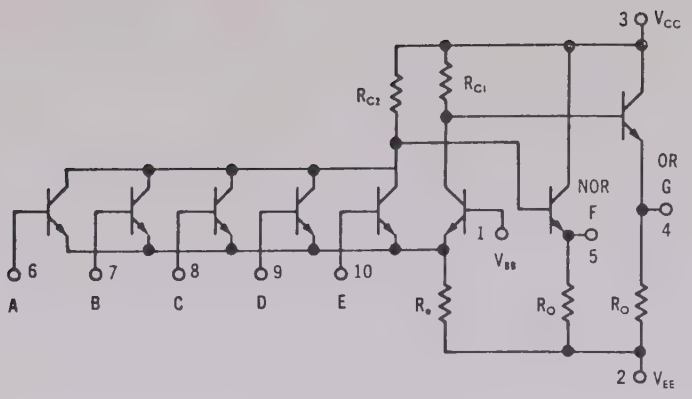
The −5.2-volt regulator operates from the unregulated DC voltage at full-wave bridge rectifier A6CR1. A −6-volt reference, established zener diode A3CR1, controls the base biasing of series control A3Q3. This reference maintains the base biasing of A3Q3 at a constant level thereby clamping the series control output at −5.2 volts.



NOTE:

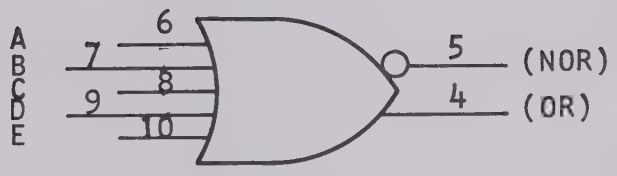
1. EMR DRAWING CONTROL NO. 2726-006.

Figure 4-4. Power Supply and Regulator Circuits, Block Diagram



V_{CC}--GROUND
V_{BB}-- -1.15V
V_{EE}-- -5.2V

SCHEMATIC DIAGRAM



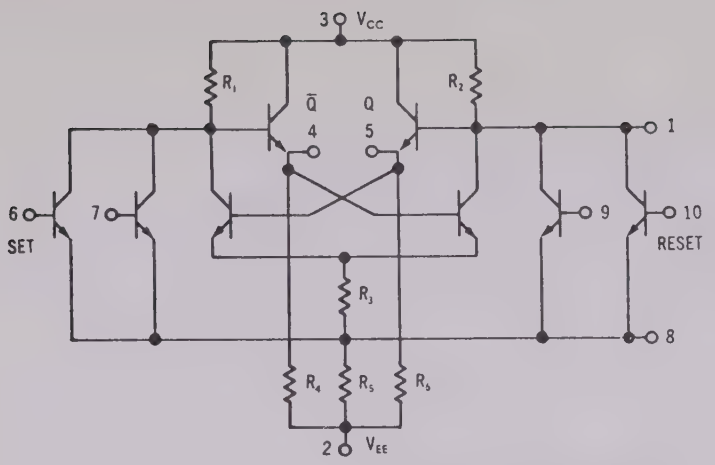
LOGIC DIAGRAM

TRUTH TABLE

A	B	C	D	E	OR	NOR
0	0	0	0	0	0	1
1	0	0	0	0	1	0
0	1	0	0	0	1	0
0	0	1	0	0	1	0
0	0	0	1	0	1	0
0	0	0	0	1	1	0
1	1	1	1	1	1	0

LOGIC LEVELS
1 = -0.7V 0 = -1.5V

Figure 4-5. Five-Input OR/NOR Integrated-Circuit Module (MC351G)



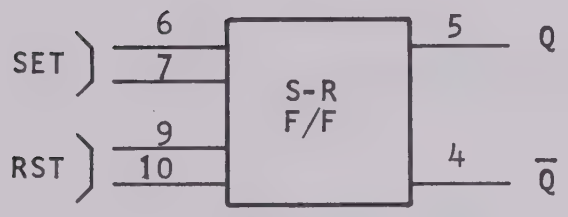
SCHEMATIC DIAGRAM

V_{CC}--GRD

V_{EE}-- -5.2V

1--(NOT USED)

8--(NOT USED)



LOGIC DIAGRAM

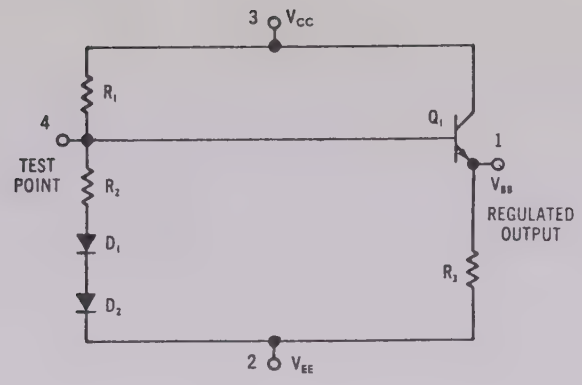
TRUTH TABLE

S	R	Q	$\bar{Q}$
1	0	1	0
0	1	0	1
0	0	*	*
1	1	**	**

LOGIC LEVELS
1 = -0.7V 0 = -1.5V

*NO CHANGE FROM PREVIOUS STATE
**INDETERMINATE

Figure 4-6. DC Set/Reset Flip-Flop Integrated-Circuit Module (MC352G)



SCHEMATIC DIAGRAM

CIRCUIT FUNCTION

THE MC354G MODULE OPERATES AS A TEMPERATURE-COMPENSATING REGULATOR USED WITH THE MC350-SERIES INTEGRATED-CIRCUIT MODULES.

CIRCUIT DESCRIPTION

THE DIVIDER NETWORK R_1, R_2, D_1, D_2 COMPENSATES FOR TEMPERATURE VARIATIONS OF THE BASE-EMITTER VOLTAGES OF Q_1 AND OF THE DRIVEN GATES, PRODUCING A BIAS VOLTAGE FOR THE ASSOCIATED LOGIC CIRCUITS THAT MAINTAINS A CONSTANT SET OF DC OPERATING CONDITIONS OVER THE TEMPERATURE RANGE OF 0 TO +75°C. IN ADDITION, COMPENSATION FOR POWER-SUPPLY VARIATIONS IS ACHIEVED, SINCE THE BIAS OUTPUT VOLTAGE IS DERIVED FROM THE SYSTEM SUPPLY.

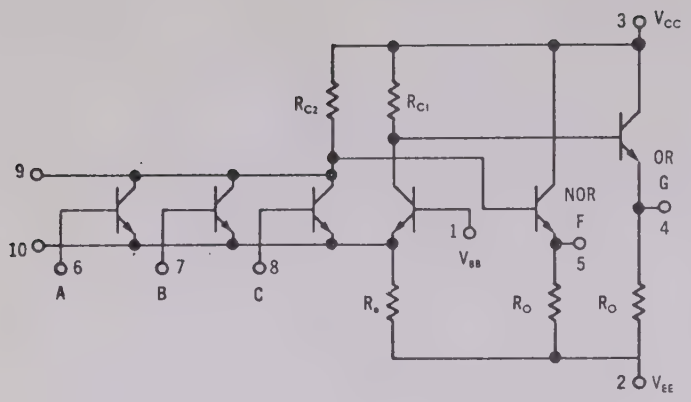
THE BIAS DRIVER TERMINAL VOLTAGES ARE AS FOLLOWS:

V_{CC}--0 VOLT (SIGNAL GROUND)

V_{EE}-- -5.2 VOLTS (POWER-SUPPLY INPUT)

V_{BB}-- -1.15 VOLTS (NOMINAL OUTPUT AT 25°C)

Figure 4-7. Bias Driver Integrated-Circuit Module (MC354G)

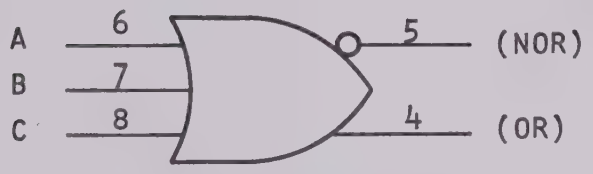


V_{CC}--GROUND

V_{BB}-- -1.15V

V_{EE}-- -5.2V

SCHEMATIC DIAGRAM



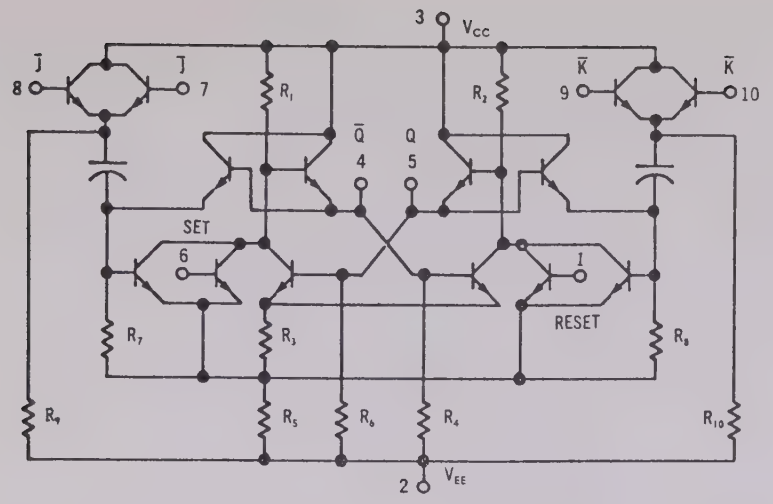
LOGIC DIAGRAM

TRUTH TABLE

A	B	C	OR	NOR
0	0	0	0	1
1	0	0	1	0
0	1	0	1	0
0	0	1	1	0
1	1	1	1	0

LOGIC LEVELS
1 = -0.7V 0 = -1.5V

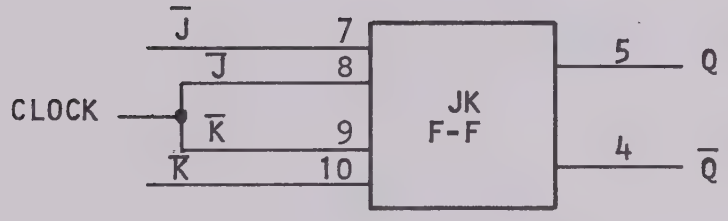
Figure 4-8. Three-Input OR/NOR Integrated-Circuit Module (MC356G)



SCHEMATIC DIAGRAM

V_{CC}--GRD

V_{EE}-- -5.2V



LOGIC DIAGRAM

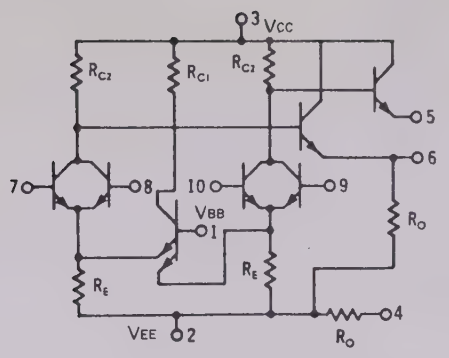
TRUTH TABLE

CLOCK	$\overline{J}$	$\overline{K}$	Q	$\overline{Q}$
1	1	0	0	1
1	0	1	1	0
1	0	0	*	*
1	1	1	**	**

LOGIC LEVELS
1 = -0.7V 0 = -1.5V

*CHANGES FROM PREVIOUS STATE.
** NO CHANGE FROM PREVIOUS STATE.

Figure 4-9. JK Flip-Flop Integrated-Circuit Module (MC358G)

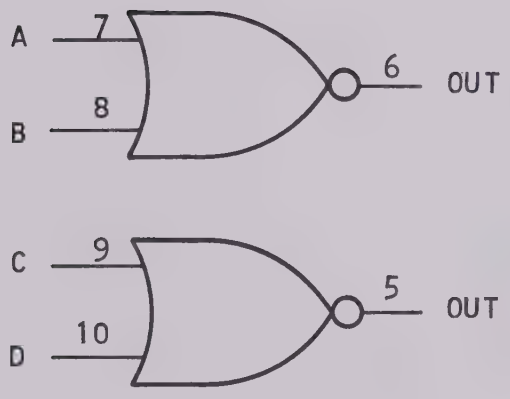


V_{CC}--GRD

V_{BB}-- -1.15V

V_{EE}-- -5.2V

SCHEMATIC DIAGRAM



LOGIC DIAGRAM

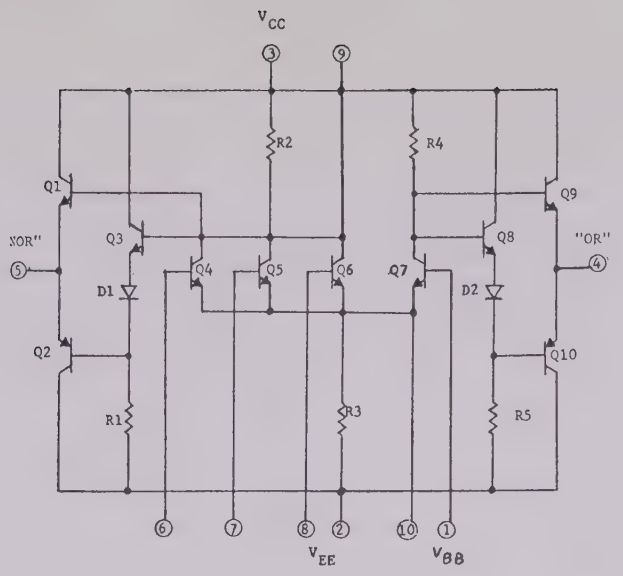
TRUTH TABLE

7*	8**	OUT
0	0	1
1	0	0
0	1	0
1	1	0

LOGIC LEVELS
1 = -0.7V 0 = -1.5V

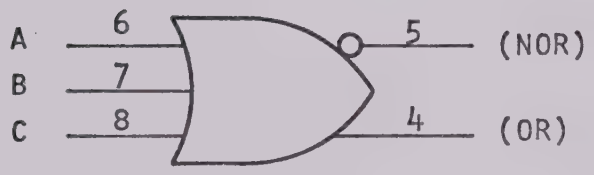
*A OR C
**B OR D

Figure 4-10. Dual NOR Integrated-Circuit Module (MC360G)



V_{CC}--GROUND
V_{BB}-- -1.15V
V_{EE}-- -5.2V

SCHEMATIC DIAGRAM



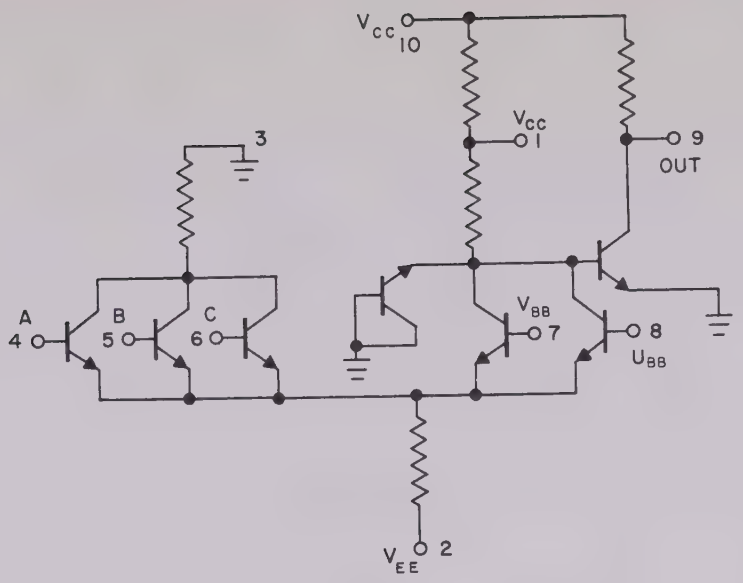
LOGIC DIAGRAM

TRUTH TABLE

A	B	C	OR	NOR
0	0	0	0	1
1	0	0	1	0
0	1	0	1	0
0	0	1	1	0
1	1	1	1	0

LOGIC LEVELS
1 = -0.7V 0 = -1.5V

Figure 4-11. Line Driver Integrated-circuit Module (MC365G)

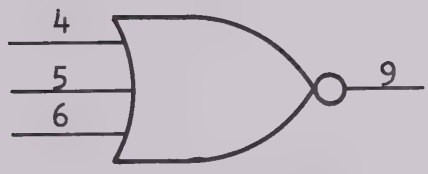


V_{CC}-- +5V

V_{BB}-- -1.15V

V_{EE}-- -5.2V

SCHEMATIC DIAGRAM



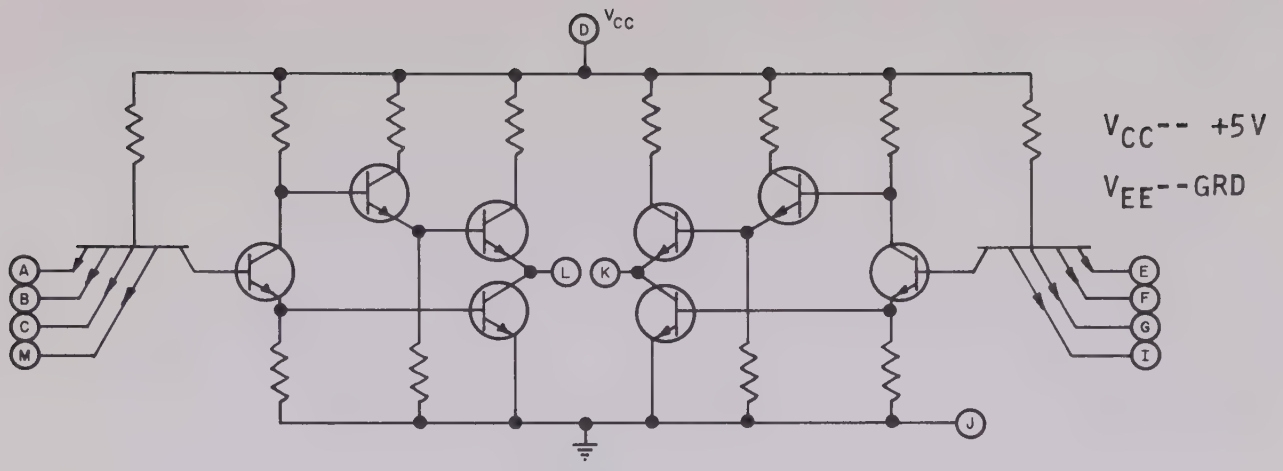
LOGIC DIAGRAM

TRUTH TABLE

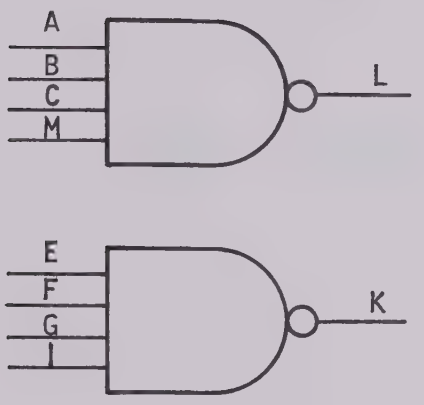
A	B	C	OUT
0	0	0	1
1	0	0	0
0	1	0	0
0	0	1	0
1	1	1	0

LOGIC LEVELS	
INPUTS	1 = -0.7V 0 = -1.5V
OUTPUTS	1 = 0V 0 = +5V

Figure 4-12. Level Shifter Integrated-Circuit Module (MC367G)



SCHEMATIC DIAGRAM



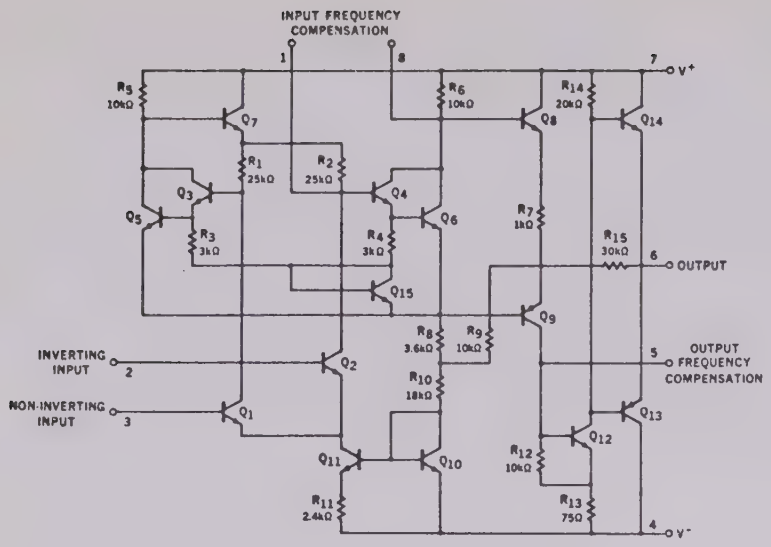
LOGIC DIAGRAM

TRUTH TABLE

A	B	C	M	OUT
0	0	0	0	1
1	1	1	1	0

LOGIC LEVELS
1 = +5V 0 = 0V

Figure 4-13. Output Driver Integrated-Circuit Module (SG42-03)

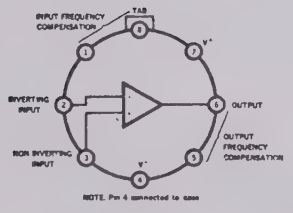


1--GRD

4-- -5.2V

8-- +18V

SCHEMATIC DIAGRAM



CONNECTION DIAGRAM

Figure 4-14. Wide-Band DC Amplifier Integrated-Circuit Module (μA709C)

SECTION 5

MAINTENANCE

5.1 GENERAL

This section contains information to aid in troubleshooting and maintaining the Model 2726 PCM Signal Conditioner and Model 2727 NRZC, NRZM, NRZS, and RZ Selector Modules. This information is intended for use with the theory of operation, contained in Section 4, so that maintenance may be performed with maximum efficiency. Included in the maintenance information are troubleshooting guides (paragraph 5.2), wiring (paragraph 5.3), and assembly and schematic diagrams for all signal-conditioner subassemblies (Figures 5-1 through 5-15).

5.2 TROUBLESHOOTING

In the event an abnormal condition is detected in signal-conditioner operation, the following general method of isolating and repairing the trouble is recommended:

a. Perform visual inspection (paragraph 5.2.1).

b. Perform test and adjustment procedure to isolate the malfunctioning circuit (paragraph 5.2.2).

c. Malfunctioning component is isolated by using integrated-circuit-module descriptions (Figures 4-5 through 4-13), schematic and assembly diagrams (Figures 5-1 through 5-15), and waveform and transistor voltage measurement tables (Tables 5-1 and 5-2).

d. When defective component is located, refer to Section 6, Parts Lists, for replacement component information.

e. Perform test and adjustment procedure to ensure that malfunction is corrected (paragraph 5.2.2).

5.2.1 Visual Inspection

The signal conditioner should be subjected to a regular inspection program similar to that recommended for other types of electronic equipment. The following inspection should be performed periodically as a means of preventive maintenance or, if a malfunction occurs, to aid in isolating the trouble.

a. Inspect front- and rear-panel components for signs of damage.

b. Inspect printed-circuit cards and mating connectors for mechanical damage or component discoloration.

c. Inspect wiring for loose or broken connections.

5.2.2 Test and Adjustment Procedure

This procedure is designed to check the operational status of the signal conditioner and make necessary adjustments in particular circuits. The procedure may be performed periodically to ensure the operational readiness of the unit or, if a malfunction occurs, to isolate a trouble. Associated information to be used in conjunction with the test and adjustment procedure is contained in the integrated-circuit module descriptions, schematic and assembly diagrams, and waveform and voltage-measurement tables.

The test and adjustment procedure is divided into three sections. The first section provides a list of necessary test equipment required. The second and third sections outline the steps in checking and adjusting the power supply and regulator circuits, and the signal-conditioning circuits.

5.2.2.1 Test Equipment Required

1 - Tektronix 545A Oscilloscope, or equivalent
1 - Tektronix Type M Plug In, or equivalent
1 - PCM Signal Simulator
1 - Hewlett Packard 3459A Digital Voltmeter, or equivalent
1 - Beckman 7360 Frequency Meter, or equivalent

5.2.2.2 Power Supply and Regulator Circuits (See Figures 5-1, 5-6, 5-7, and 5-15)

a. Using a DC voltmeter, check regulated output voltages as follows:

A6TP1-- −18 volts ±20 millivolts
A6TP3-- +18 volts ±20 millivolts
A3J7-L-- −5.2 volts ±10%

If the +18- and −18-volt outputs are not as stated, adjust potentiometers A6R10 or A6R22 to obtain proper voltage levels. The −5.2-volt regulator does not contain a voltage adjustment.

b. Should a malfunction occur in the regulator circuits, troubleshoot circuits using typical voltage measurements provided in Table 5-2.

5.2.2.3 Signal Conditioning Circuits (See Figure 4-2)

a. Using a PCM signal simulator, apply an external PCM input to rear-panel connector A2J2 with the following parameters:

   1. Code--NRZC (for all selector modules)

   2. Pattern--Alternate 1-0

   3. Bit-Rate--Established by selector module

   4. Input Level--0.5 volt peak-to-peak

b. Set signal-conditioner front-panel controls as follows:

   1. POWER switch to ON

   2. RANGE switch to 10V

   3. POLARITY switch to NORM

c. Using an oscilloscope, observe the waveform at A3J7-W. Waveform should be as shown in waveform 1 of Table 5-1.

d. Using an oscilloscope, observe waveform at the common connection of C4 and C5 in the selector module. Waveform should be as shown in waveform 2 of Table 5-1.

e. Using an oscilloscope, monitor A4TP2 and adjust LIM BAL potentiometer A4R18 for a symmetrical square-wave indication. Waveform should be as shown in waveform 3 of Table 5-1.

f. Using an oscilloscope, monitor A4TP1 and adjust PH SH BAL potentiometer A4R34 for a symmetrical square-wave indication. Waveform should be as shown in waveform 4 of Table 5-1.

g. Install a clip lead between A5TP1 and A5TP2 and adjust LP BAL potentiometer A5R8 for an approximate center-scale indication on the front-panel DEV meter M1. Remove clip lead.

h. On the external PCM signal simulator, change the PCM signal parameters to the following:

   1. Code--Established by selector module (use NRZM code for NRZM and NRZS selector modules).

2. Pattern--1 0 1 0 0 0 0 0 (repeating word pattern).

3. Bit Rate--Established by selector module.

4. Input Level--0.5 volt peak-to-peak.

i. On the signal-conditioner front panel, adjust the BALANCE control for a center-scale indication on the DEV meter M1.

j. Trigger the oscilloscope on the negative edge of an external signal occurring at the beginning of each repeating pattern in the PCM signal. Typically, a word-rate pulse output from the signal simulator.

k. Using an oscilloscope with an external trigger as specified in step j, observe the waveforms at A3J6-R, A3J6-P, and A3J6-X. Waveforms should be as shown in waveforms 5, 6, and 7, respectively, of Table 5-1.

l. Disconnect the PCM input signal at rear-panel connector A2J2 and adjust SIG LOSS potentiometer A5R5 until the front-panel LOSS LOCK indicator just illuminates. Reconnect PCM input signal and observe that the LOSS LOCK indicator extinguishes.

m. On the external signal simulator, deviate the PCM input signal bit rate an amount equal to the tracking range of the signal conditioner. (Refer to Table 2-1 for tracking-range identification.) Signal conditioner should remain in lock condition over entire tracking range. Return bit-rate setting to the selected bit-rate frequency and balance unit as in step i.

n. Using an oscilloscope, observe the waveform at A3J9-21. Position the front-panel POLARITY switch to INVERT and observe that the waveform inverts. Position the POLARITY switch to NORM.

o. Using an oscilloscope, observe the waveforms at A3J9-6, A3J9-7, and A3J9-28. Waveforms should be as shown in waveforms 8, 9, and 10, respectively, in Table 5-1.

p. Using an oscilloscope, observe the waveforms at A3J7-5, A3J7-12, and A3J7-F. Waveforms should be as shown in waveforms 11, 12, and 13, respectively, in Table 5-1.

q. On the external signal simulator, increase the PCM input signal level to 10 volts peak-to-peak and observe the signal conditioner front-panel INPUT meter for an appropriate 10-volt indication.

r. Position the signal-conditioner front-panel RANGE switch to 30V.

s. On the external signal simulator, increase the PCM input signal level to 15 volts peak-to-peak and observe the signal-conditioner front-panel INPUT meter for a 15-volt indication.

5.3 WIRING

The signal-conditioner wiring information is contained in the detailed block diagram, Figure 4-2, and the power distribution diagram, Figure 5-15.

Table 5-1. Model 2726 PCM Signal Conditioner
And Model 2727 NRZC, NRZM, NRZS, and RZ Selector Modules,
Typical Waveforms

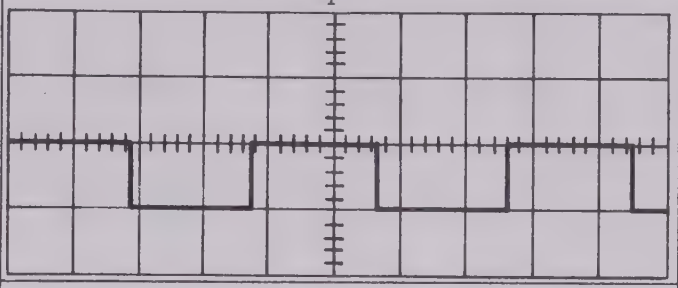
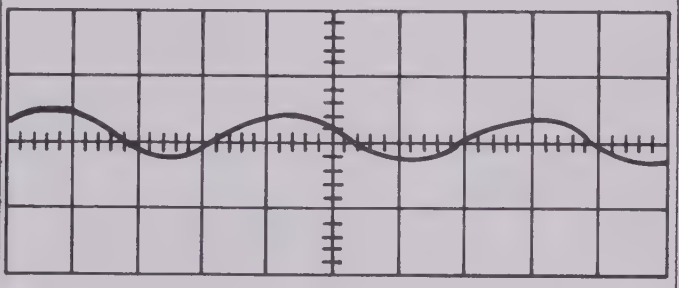
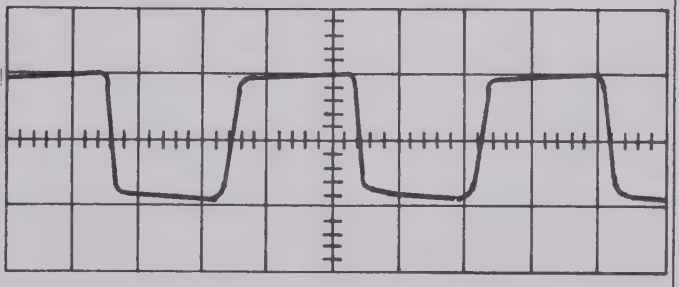
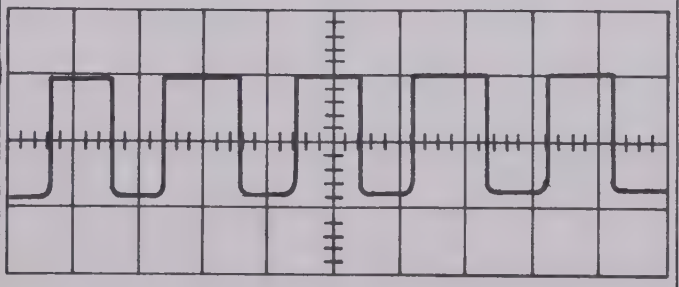
CIRCUIT LOCATION	INPUT	WAVEFORM	OSCILLOSCOPE	
			VERT.	HORIZ.
A3J7-W	NRZC PCM at 0.5 volt P-P (all selectors)	1 	0.5V/-Cm	Setting depends on selected bit rate
Selector Module C4-5 Junction	NRZC PCM at 0.5 volt P-P (all selectors)	2 	0.5V/-Cm	Setting depends on selected bit rate
A4TP2	NRZC PCM at 0.5 volt P-P (all selectors)	3 	0.5V/-Cm	Setting depends on selected bit rate
A4TP1	NRZC PCM at 0.5 volt P-P (all selectors)	4 	0.5V/-Cm	Setting depends on selected bit rate

Table 5-1 (Cont'd.). Model 2726 PCM Signal Conditioner And Model 2727 NRZC, NRZM, NRZS, and RZ Selector Modules, Typical Waveforms

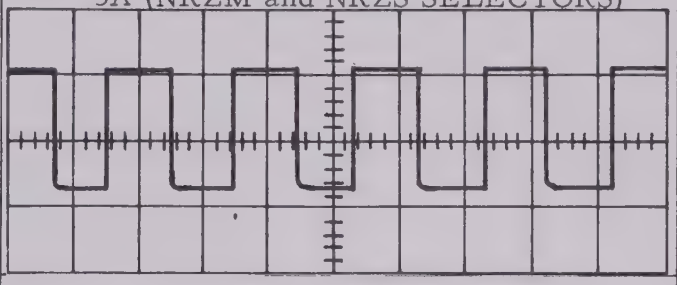
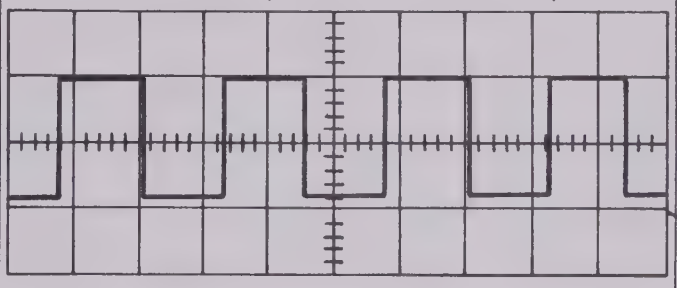
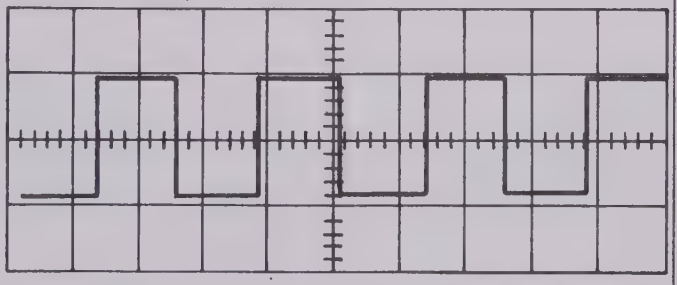
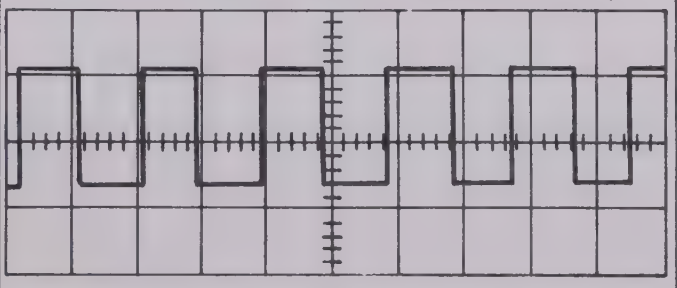
CIRCUIT LOCATION	INPUT	WAVEFORM	OSCILLOSCOPE	
			VERT.	HORIZ.
A3J6-R	NRZM PCM at 0.5 volt P-P	5A (NRZM and NRZS SELECTORS) 	0.5V/-Cm	Setting depends on selected bit rate
A3J6-R	NRZC PCM at 0.5 volt P-P	5B (NRZC SELECTOR) 	0.5V/-Cm	Setting depends on selected bit rate
A3J6-R	RZ PCM at 0.5 volt P-P	5C (RZ SELECTOR) 	0.5V/-Cm	Setting depends on selected bit rate
A3J6-P	NRZM PCM at 0.5 volt P-P	6A (NRZM and NRZS SELECTORS) 	0.5V/-Cm	Setting depends on selected bit rate

Table 5-1 (Cont'd.). Model 2726 PCM Signal Conditioner And Model 2727 NRZC, NRZM, NRZS, and RZ Selector Modules, Typical Waveforms

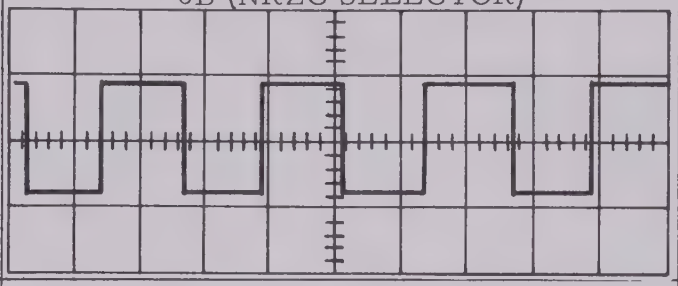
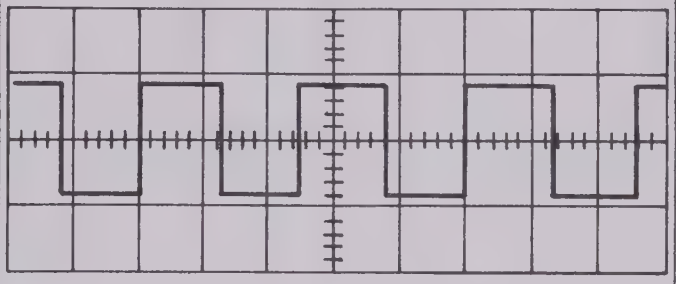
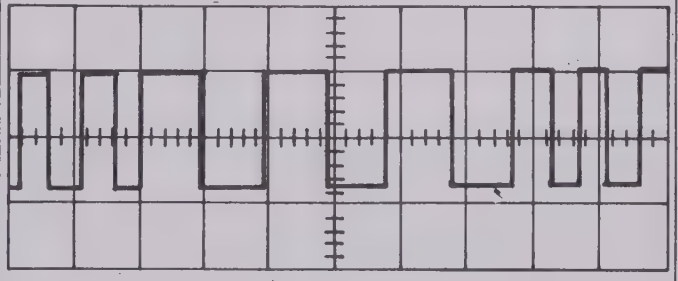
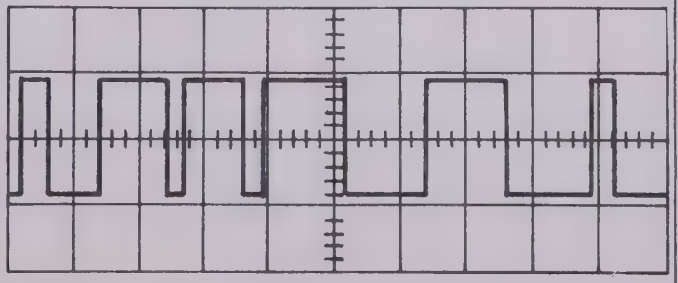
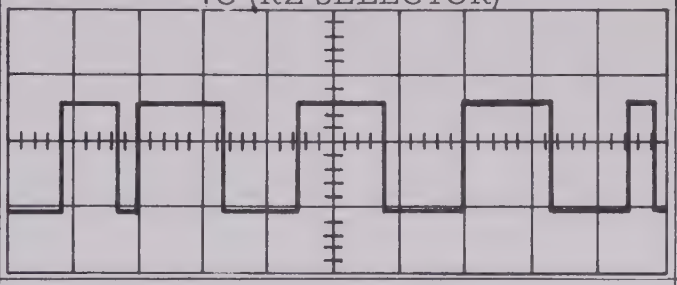
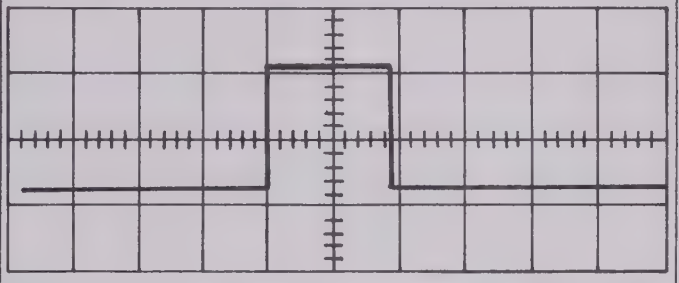
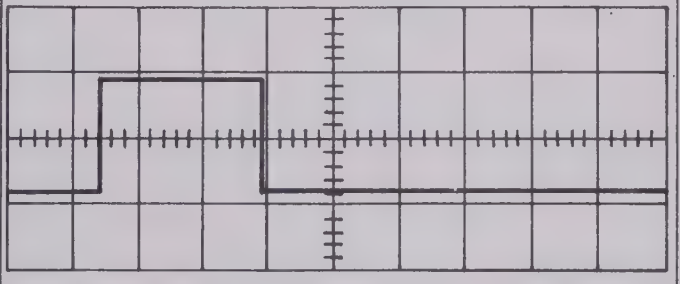
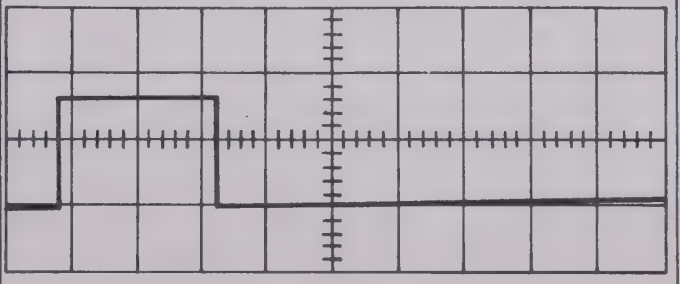
CIRCUIT LOCATION	INPUT	WAVEFORM	OSCILLOSCOPE	
			VERT.	HORIZ.
A3J6-P	NRZC PCM at 0.5 volt P-P	6B (NRZC SELECTOR) 	0.5V/-Cm	Setting depends on selected bit rate
A3J6-P	RZ PCM at 0.5 volt P-P	6C (RZ SELECTOR) 	0.5V/-Cm	Setting depends on selected bit rate
A3J6-X	NRZM PCM at 0.5 volt P-P	7A (NRZM and NRZS SELECTORS) 	0.5V/-Cm	Setting depends on selected bit rate
A3J6-X	NRZC PCM at 0.5 volt P-P	7B (NRZC SELECTOR) 	0.5V/-Cm	Setting depends on selected bit rate

Table 5-1 (Cont'd.). Model 2726 PCM Signal Conditioner And Model 2727 NRZC, NRZM, NRZS, and RZ Selector Modules, Typical Waveforms

CIRCUIT LOCATION	INPUT	WAVEFORM	OSCILLOSCOPE	
			VERT.	HORIZ.
A3J6-X	RZ PCM at 0.5 volt P-P	7C (RZ SELECTOR) 	0.5V/-Cm	Setting depends on selected bit rate
A3J9-6	NRZM PCM at 0.5 volt P-P	8A (NRZM and NRZS* SELECTORS) 	0.5V/-Cm	Setting depends on selected bit rate
A3J9-6	NRZC PCM at 0.5 volt P-P	8B (NRZC SELECTOR) 	0.5V/-Cm	Setting depends on selected bit rate
A3J9-6	RZ PCM at 0.5 volt P-P	8C (RZ SELECTOR) 	0.5V/-Cm	Setting depends on selected bit rate

*Waveform is inverted for NRZS SELECTOR.

Table 5-1 (Cont'd.). Model 2726 PCM Signal Conditioner And Model 2727 NRZC, NRZM, NRZS, and RZ Selector Modules, Typical Waveforms

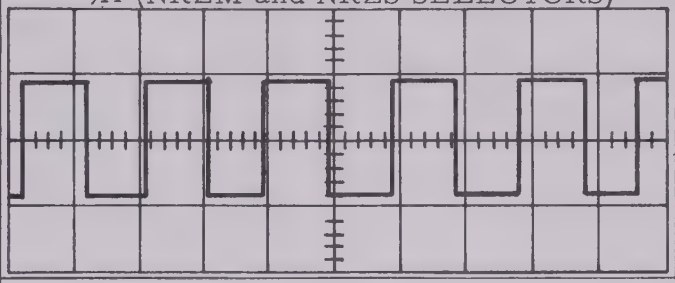
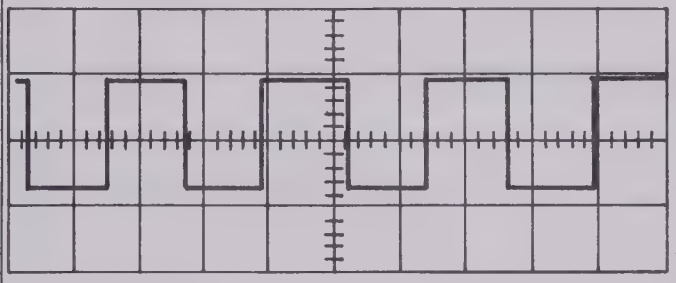
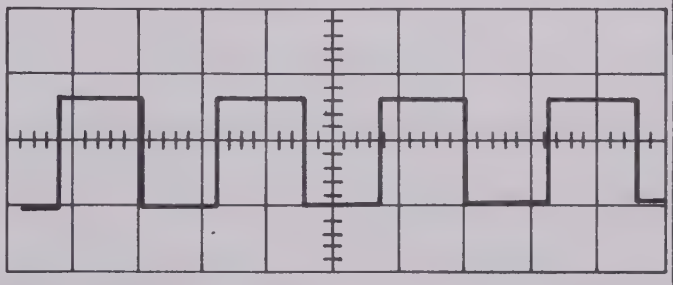
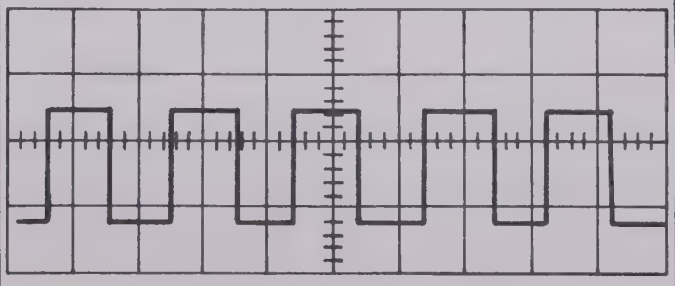
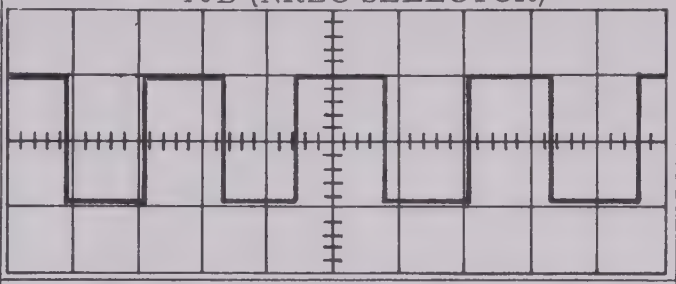
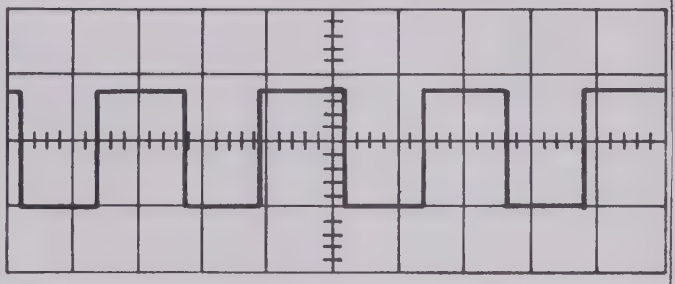
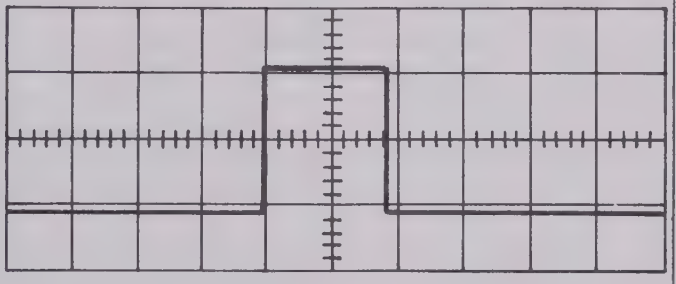
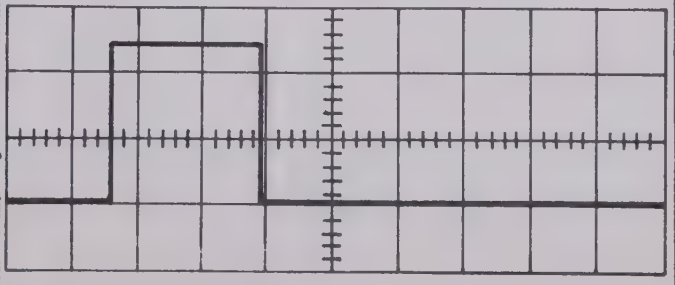
CIRCUIT LOCATION	INPUT	WAVEFORM	OSCILLOSCOPE	
			VERT.	HORIZ.
A3J9-7	NRZM PCM at 0.5 volt P-P	9A (NRZM and NRZS SELECTORS) 	0.5V/-Cm	Setting depends on selected bit rate
A3J9-7	NRZC PCM at 0.5 volt P-P	9B (NRZC SELECTOR) 	0.5V/-Cm	Setting depends on selected bit rate
A3J9-7	RZ PCM at 0.5 volt P-P	9C (RZ SELECTOR) 	0.5V/-Cm	Setting depends on selected bit rate
A3J9-28	NRZM PCM at 0.5 volt P-P	10A (NRZM and NRZS SELECTORS) 	0.5V/-Cm	Setting depends on selected bit rate

Table 5-1 (Cont'd.). Model 2726 PCM Signal Conditioner And Model 2727 NRZC, NRZM, NRZS, and RZ Selector Modules, Typical Waveforms

CIRCUIT LOCATION	INPUT	WAVEFORM	OSCILLOSCOPE	
			VERT.	HORIZ.
A3J9-28	NRZC PCM at 0.5 volt P-P	10B (NRZC SELECTOR) 	0.5V/-Cm	Setting depends on selected bit rate
A3J9-28	RZ PCM at 0.5 volt P-P	10C (RZ SELECTOR) 	0.5V/-Cm	Setting depends on selected bit rate
A3J7-5	NRZM PCM at 0.5 volt P-P	11A (NRZM and NRZS* SELECTORS) 	2.0V/-Cm	Setting depends on selected bit rate
A3J7-5	NRZC PCM at 0.5 volt P-P	11B (NRZC SELECTOR) 	2.0V/-Cm	Setting depends on selected bit rate

*Waveform is inverted for NRZS SELECTOR.

Table 5-1 (Cont'd.). Model 2726 PCM Signal Conditioner And Model 2727 NRZC, NRZM, NRZS, and RZ Selector Modules, Typical Waveforms

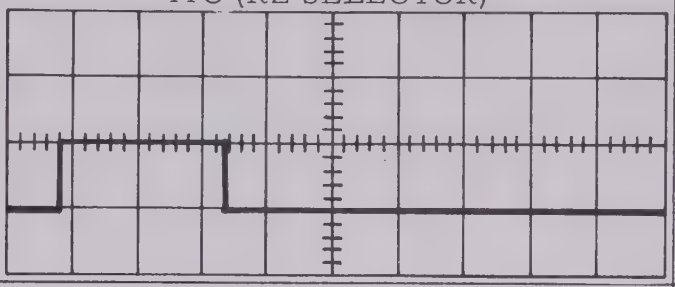
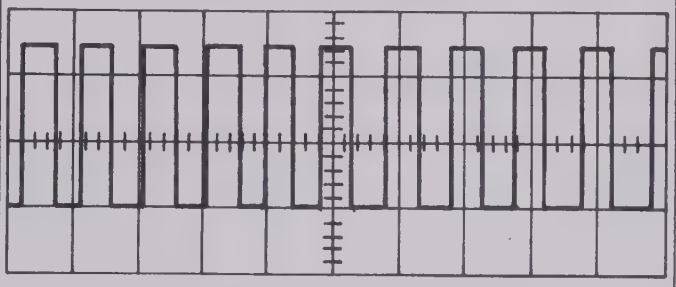
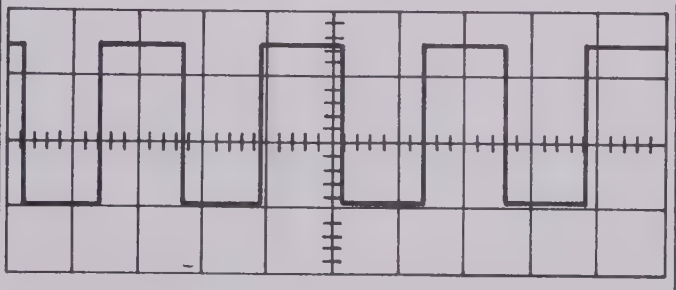
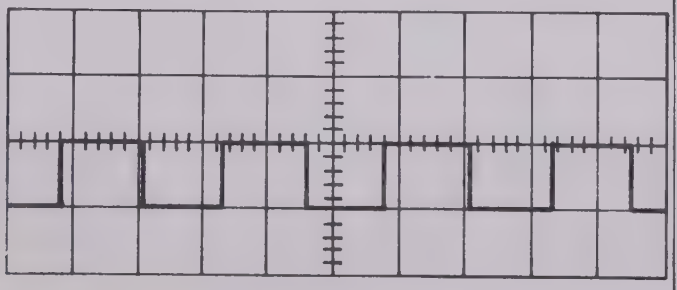
CIRCUIT LOCATION	INPUT	WAVEFORM	OSCILLOSCOPE	
			VERT.	HORIZ.
A3J7-5	RZ PCM at 0.5 volt P-P	11C (RZ SELECTOR) 	5.0V/-Cm	Setting depends on selected bit rate
A3J7-12	NRZM PCM at 0.5 volt P-P	12A (NRZM and NRZS SELECTORS) 	2.0V/-Cm	Setting depends on selected bit rate
A3J7-12	NRZC PCM at 0.5 volt P-P	12B (NRZC SELECTOR) 	2.0V/-Cm	Setting depends on selected bit rate
A3J7-12	RZ PCM at 0.5 volt P-P	12C (RZ SELECTOR) 	5.0V/-Cm	Setting depends on selected bit rate

Table 5-1 (Cont'd.). Model 2726 PCM Signal Conditioner And Model 2727 NRZC, NRZM, NRZS, and RZ Selector Modules, Typical Waveforms

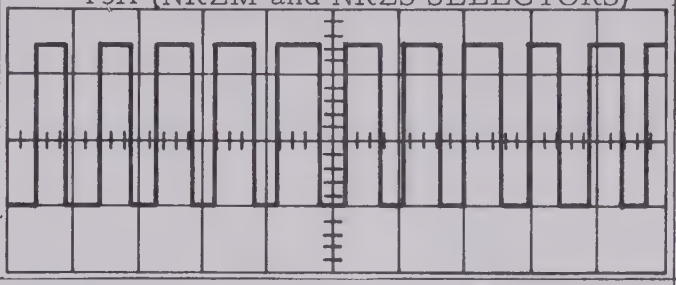
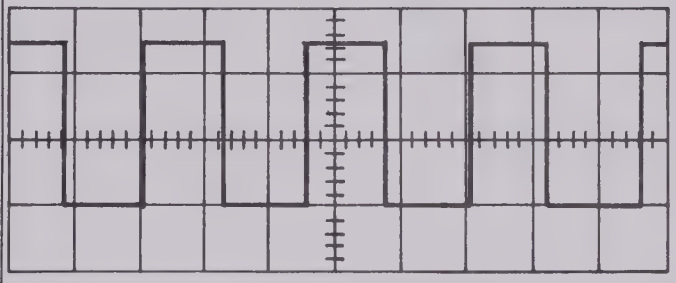
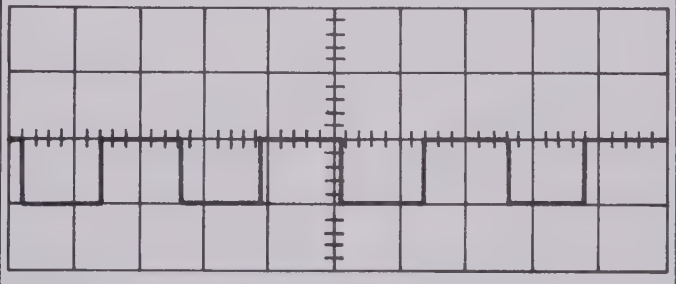
CIRCUIT LOCATION	INPUT	WAVEFORM	OSCILLOSCOPE	
			VERT.	HORIZ.
A3J7-F	NRZM PCM at 0.5 volt P-P	13A (NRZM and NRZS SELECTORS) 	2.0V/-Cm	Setting depends on selected bit rate
A3J7-F	NRZC PCM at 0.5 volt P-P	13B (NRZC SELECTOR) 	2.0V/-Cm	Setting depends on selected bit rate
A3J7-F	RZ PCM at 0.5 volt P-P	13C (RZ SELECTOR) 	5.0V/-Cm	Setting depends on selected bit rate

Table 5-2. Model 2726 PCM Signal Conditioner and Model 2727 NRZC, NRZM, NRZS, and RZ Selector Modules, Transistor Voltage Measurements

SUBASSEMBLY	TRANSISTOR	E	B	C
A3 Chassis	Q1	-18.16V	-18.25V	-26.96V
	Q2	-0.403V	-0.55V	-9.32V
	Q3	-5.55V	-5.65V	-21.6V
A4 Signal Conditioner Card*	Q1	2V PP Sig.	2V PP Sig.	+17.97V
	Q2	2V PP Sig.	2V PP Sig.	+17.91V
	Q3	1.7V PP ~	1.7V PP ~	+18.00V
	Q4	1.7V PP ~	1.7V PP ~	-18.00V
	Q5	2V PP Sig.	2V PP Sig.	-17.98V
	Q6	2V PP Sig.	2V PP Sig.	-17.92V
	Q7	2V PP Sig.	2V PP Sig.	+18.00V
A5 Synchronizer Card	Q1	0V	In Sync	
			-5.1V	+18.00V
			Out Sync	
			-0.73V	+0.21V
	Q2	-6.09V	-5.43V	0V
	Q3	-5 to -10V Sq. Wave	-5 to -10V Sq. Wave	-9.87V
	Q4	-9.87V	-10 to -14V	-5 to -10V Sq. Wave
	Q5	-9.87V	-10 to -14V	-5 to -10V Sq. Wave
	Q6	-5 to -10V Sq. Wave	-5 to -10V Sq. Wave	-9.87V
	Q7	-0.94V	-0.76V	-18.00V
	Q8	-0.94V	-1.61V	-0.98V
A6 Regulator Card	Q1	-18.25V	-18.92V	-26.96V
	Q2	-18.00V	-17.43V	-18.92V
	Q3	-26.80V	-16.78V	-18.93V
	Q4	-9.46V	-8.80V	-18.00V
	Q5	-9.46V	-8.76V	-18.93V
	Q6	-0.55V	-1.23V	-9.32V
	Q7	0V	+0.31V	-1.23V
	Q8	-9.24V	+0.98V	-1.25V
	Q9	+9.77V	+9.12V	0V
	Q10	+9.77V	+9.16V	-1.25V

*Indications, as supplied for this card, are based upon an input PCM signal coded NRZC with an alternating 1-0 pattern. Indications are valid regardless of the type of selector module installed.

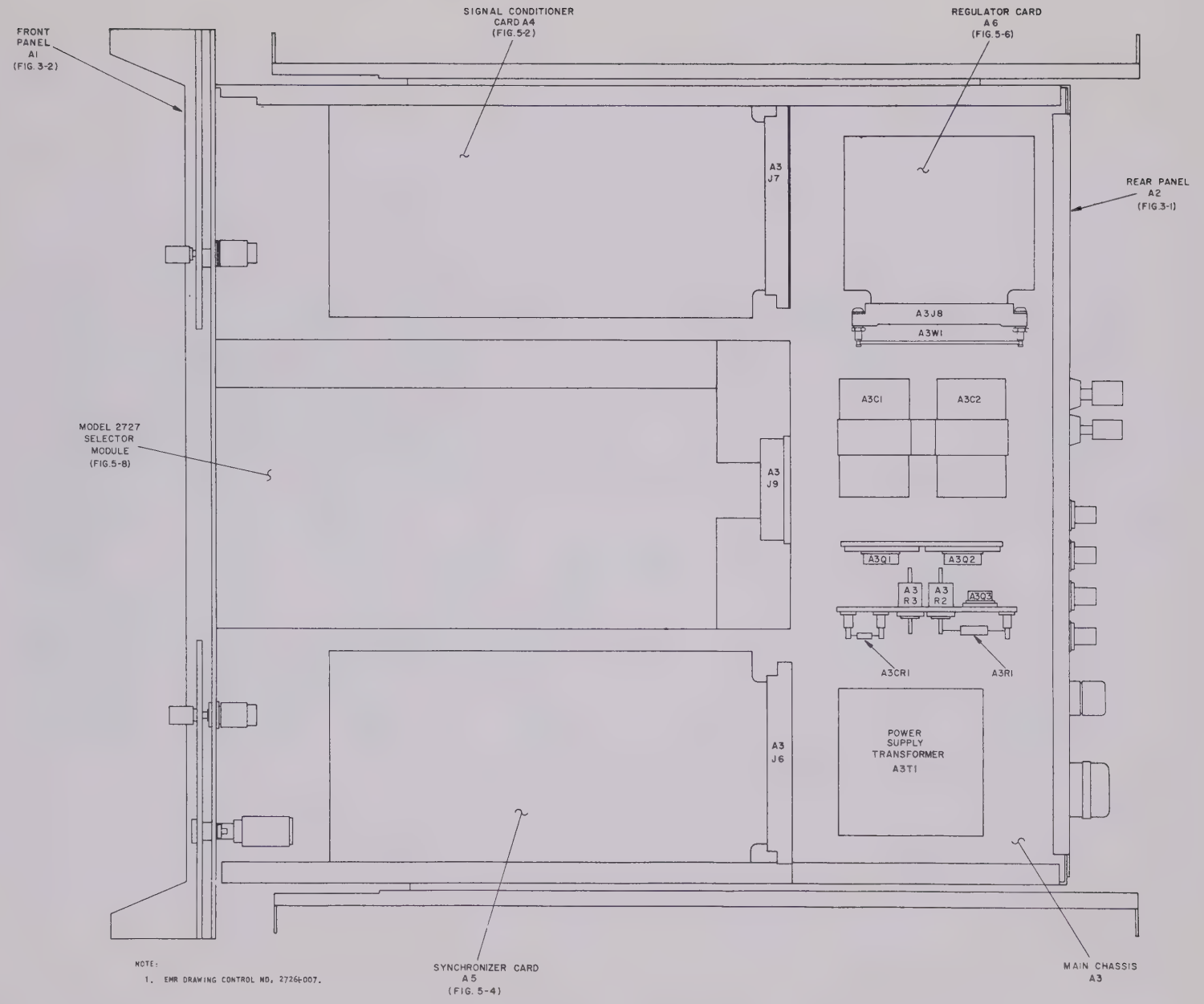
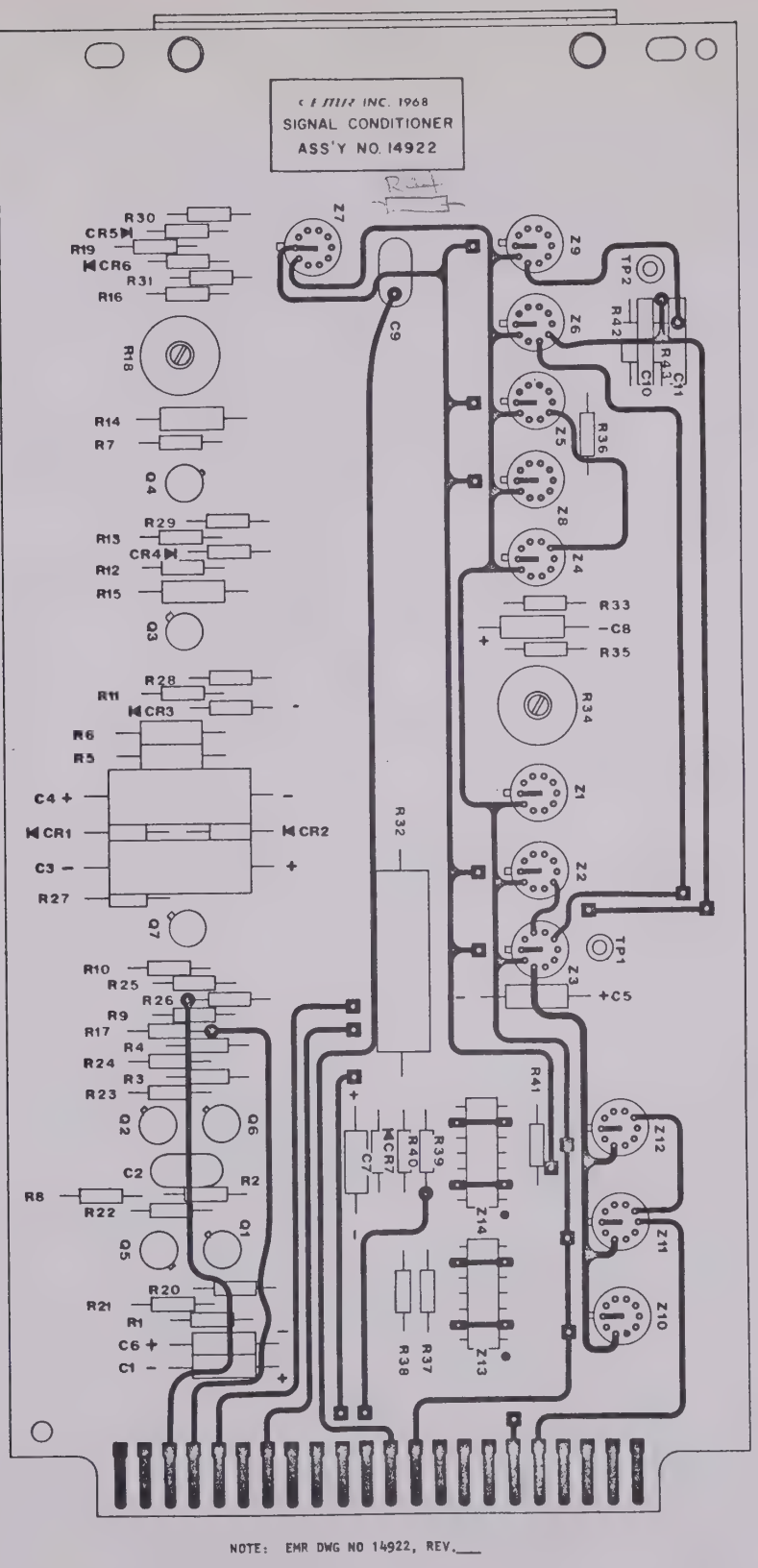


Figure 5-1. Model 2726 PCM Signal Conditioner and Model 2727 Selector Module, Assembly Diagram



NOTE: EMR DWG NO 14922, REV.___

Figure 5-2. Signal Conditioner Card A4, Location of Components

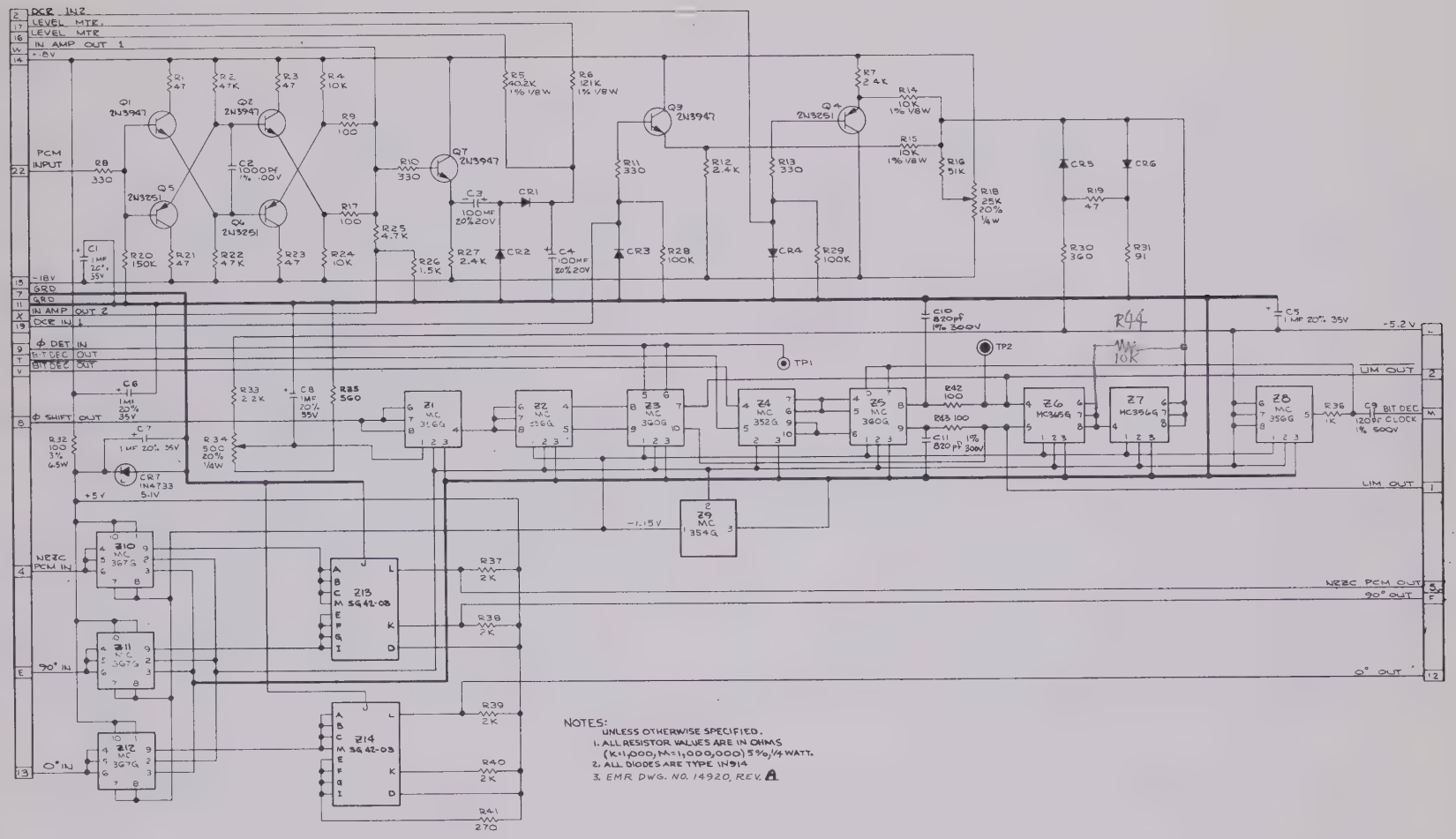
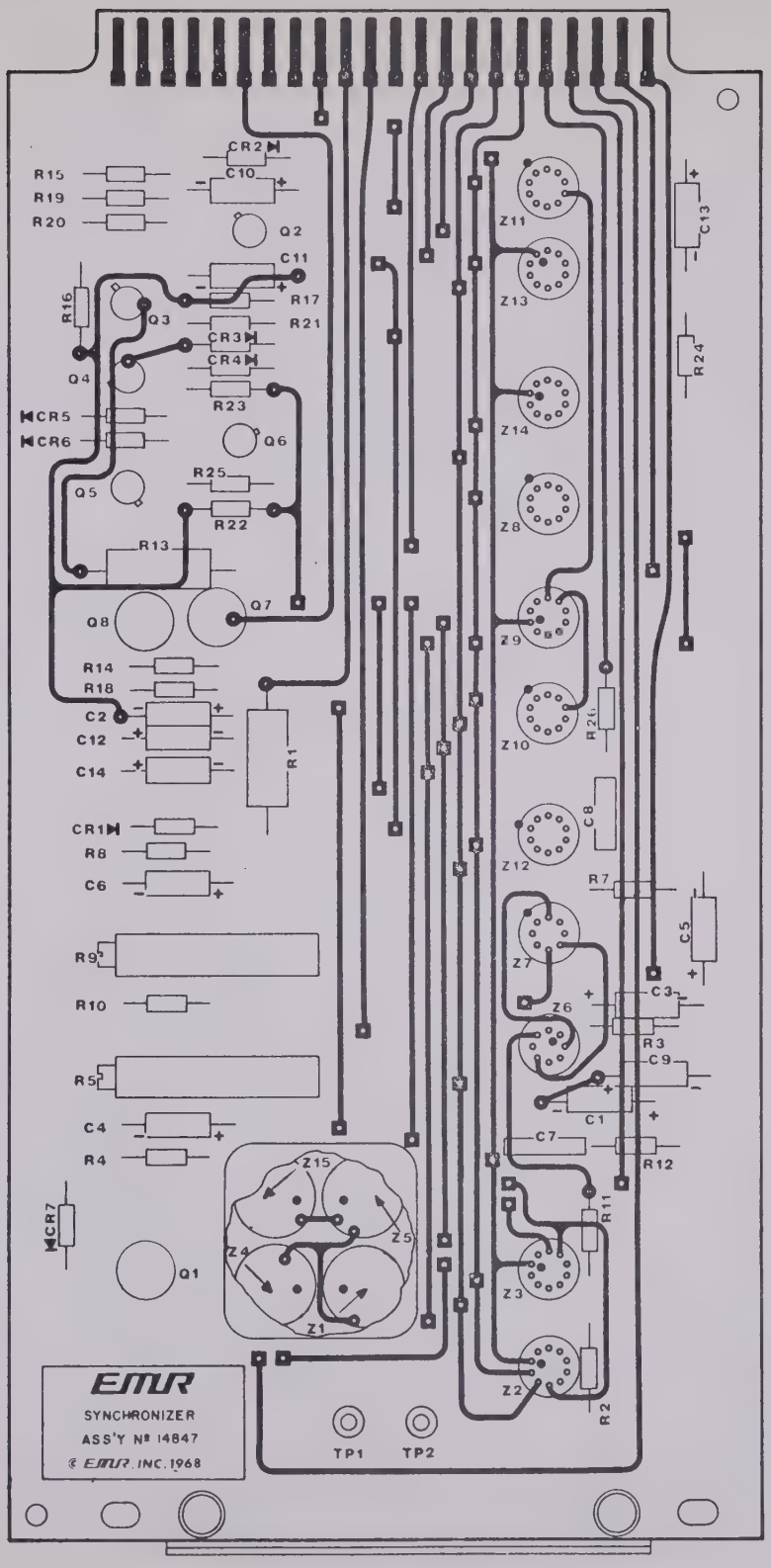
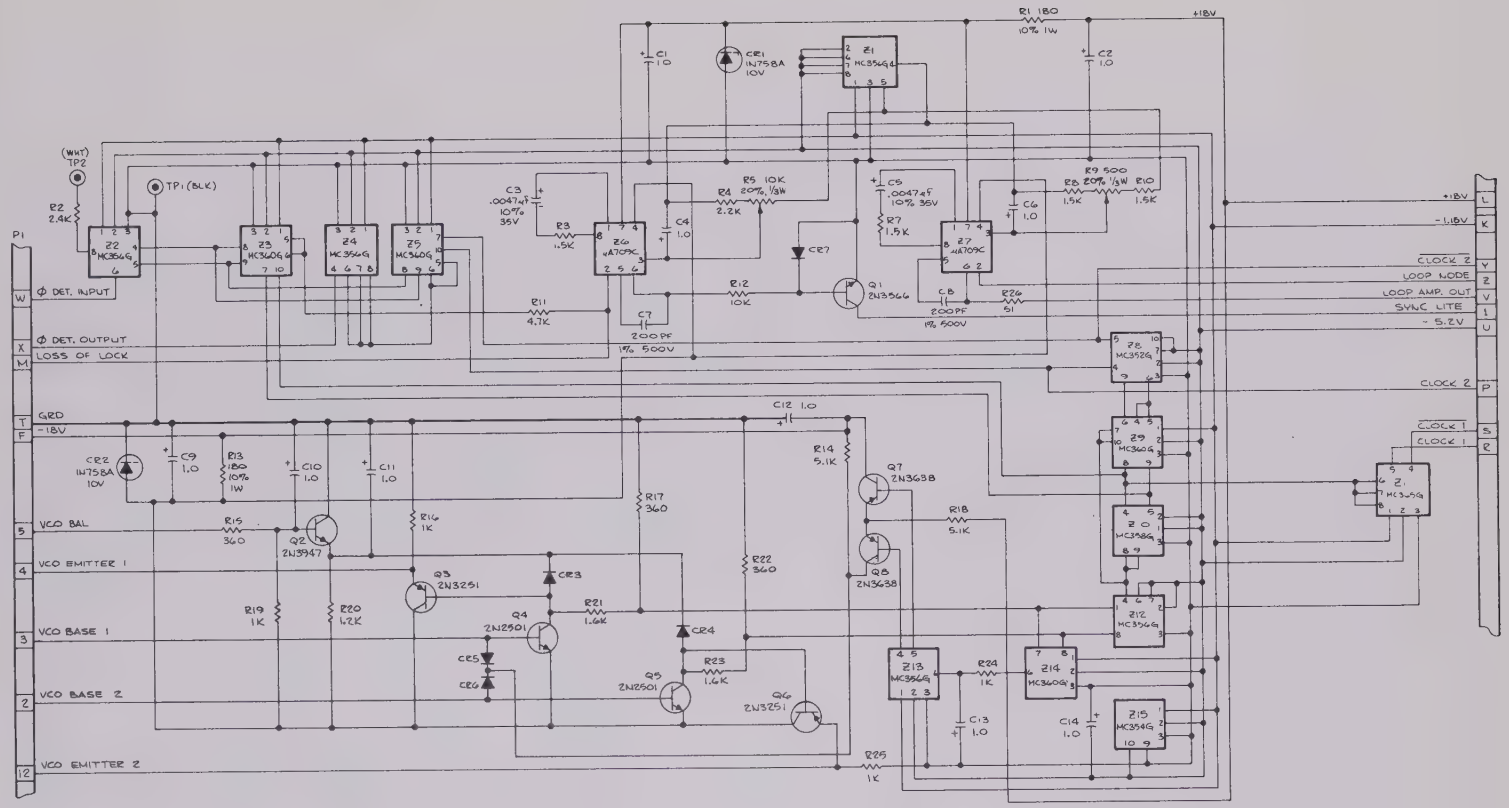


Figure 5-3. Signal Conditioner Card A4 Schematic Diagram



NOTE: EMR DWG. NO. 14847, REV.

Figure 5-4. Synchronizer Card A5, Location of Components

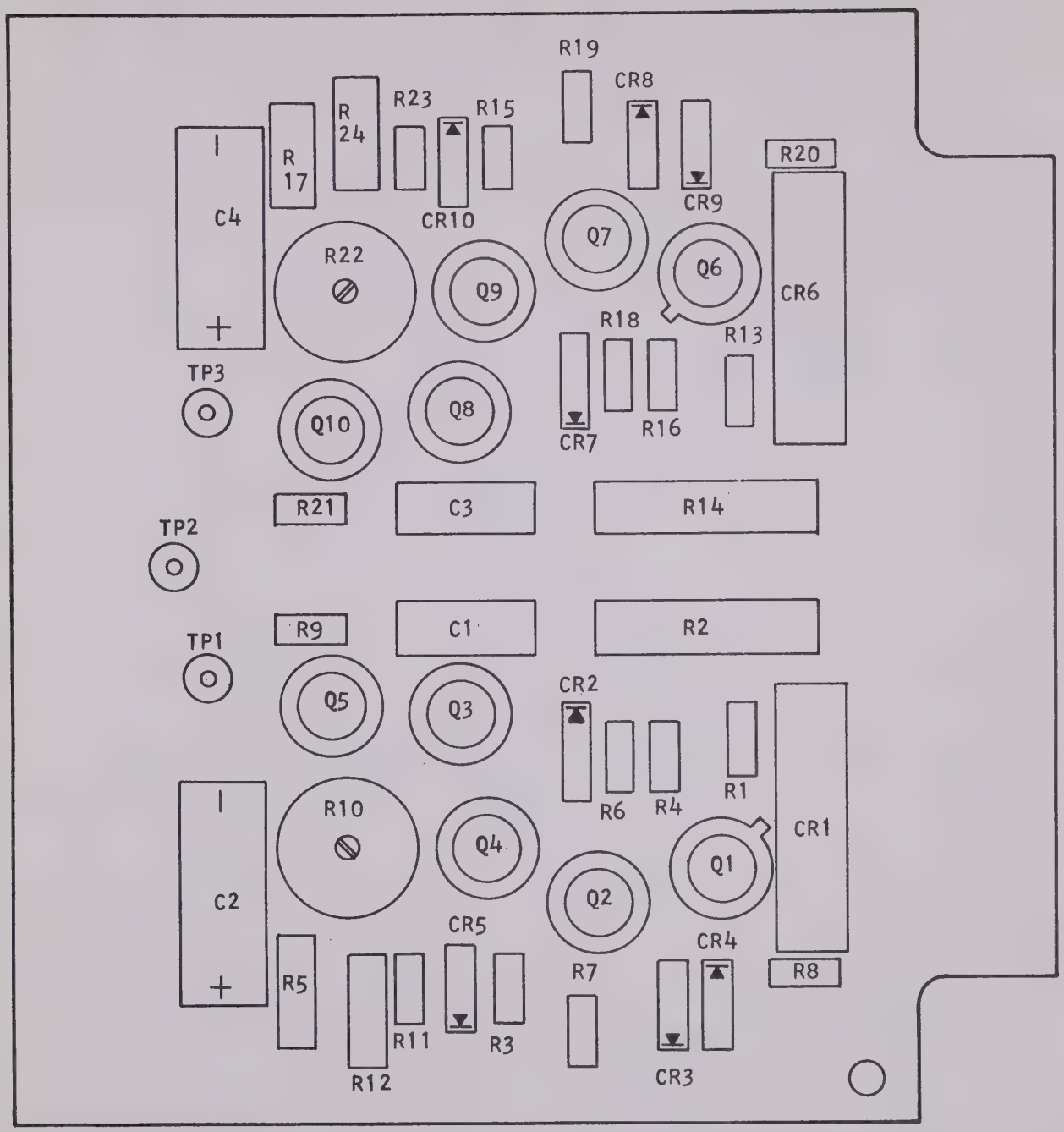


NOTES:

UNLESS OTHERWISE SPECIFIED,

1. ALL RESISTOR VALUES ARE IN OHMS (K=1000) 5% 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS, 20% 35V.
3. ALL DIODES ARE TYPE IN914.
4. EMR DWG NO. 14849, REV. B

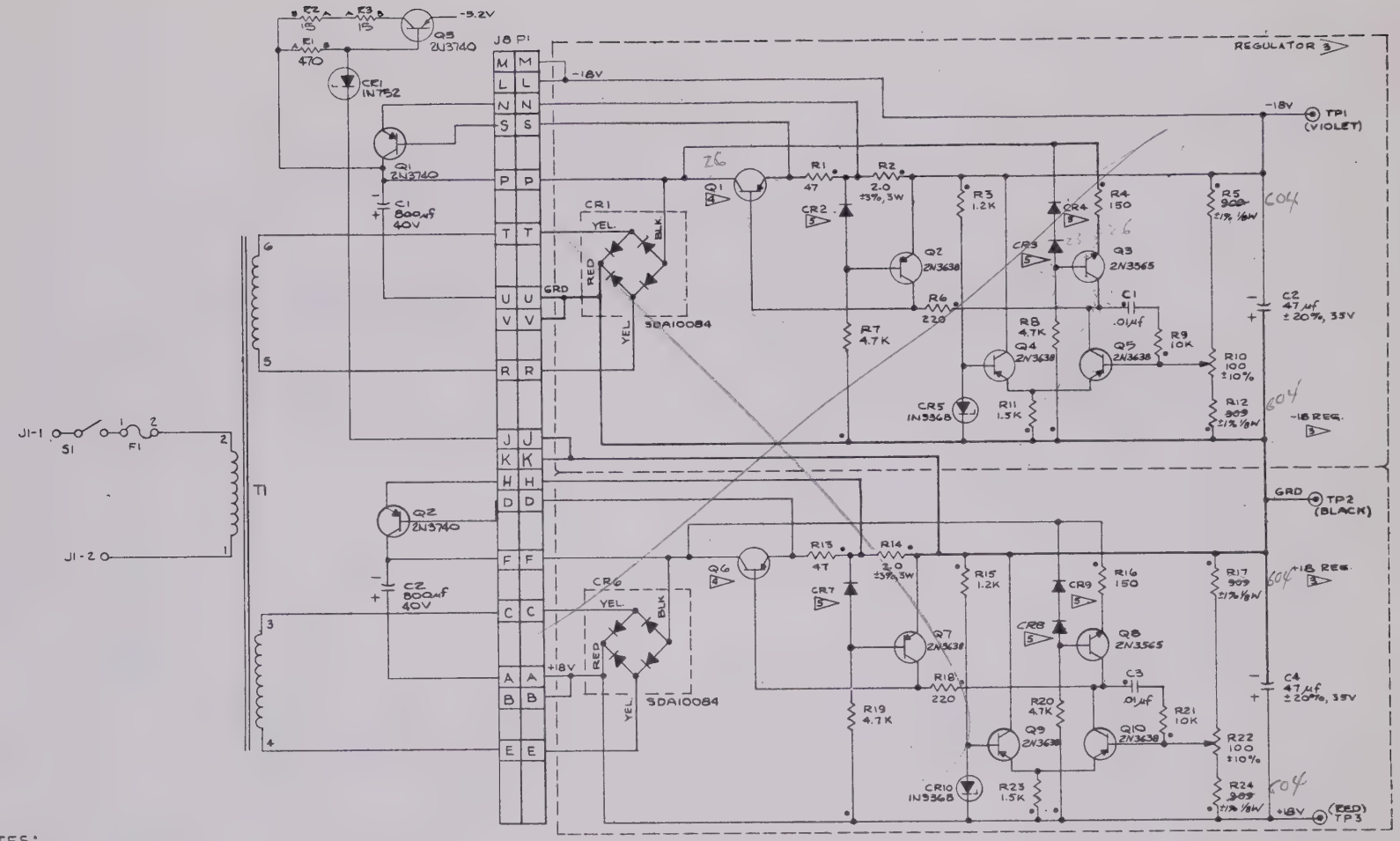
Figure 5-5. Synchronizer Card A5, Schematic Diagram



NOTE:

1. EMR DRAWING CONTROL NO. 2726-008.

Figure 5-6. Regulator Card A6, Location of Components

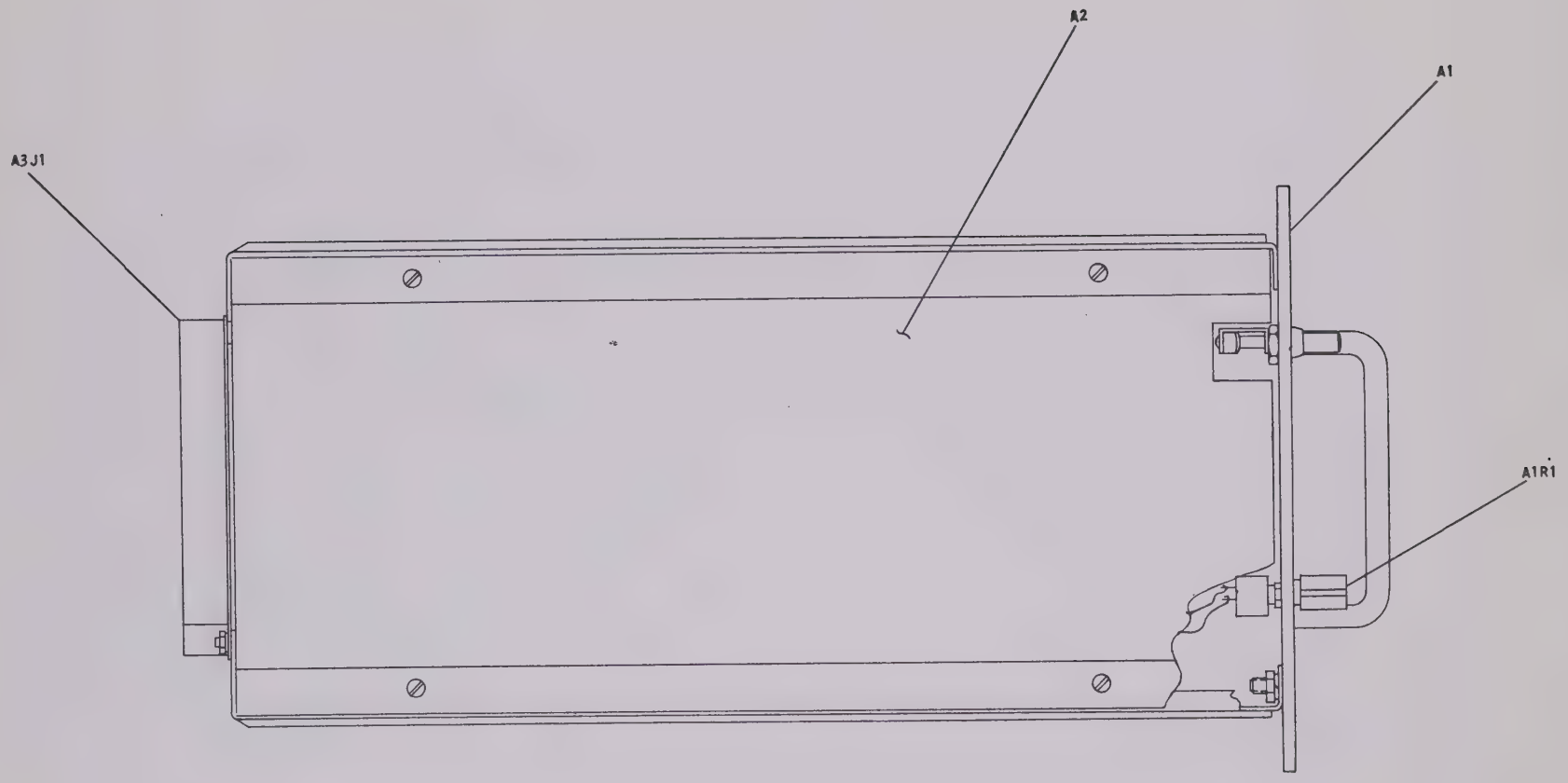


NOTES:

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS (K=1000) ±5%, 1/4 W.
2. ALL CAPACITOR VALUES ARE ±5%, 100V.
3. ALL ITEMS IN DOTTED AREAS ARE CONTAINED ON THE REGULATOR CARD
4. EMR PART NO. 694 (TYPE 2N1131).
5. EMR PART NO 663 (SIMILAR TO IN816)
6. EMR DWG. NO. 8834.

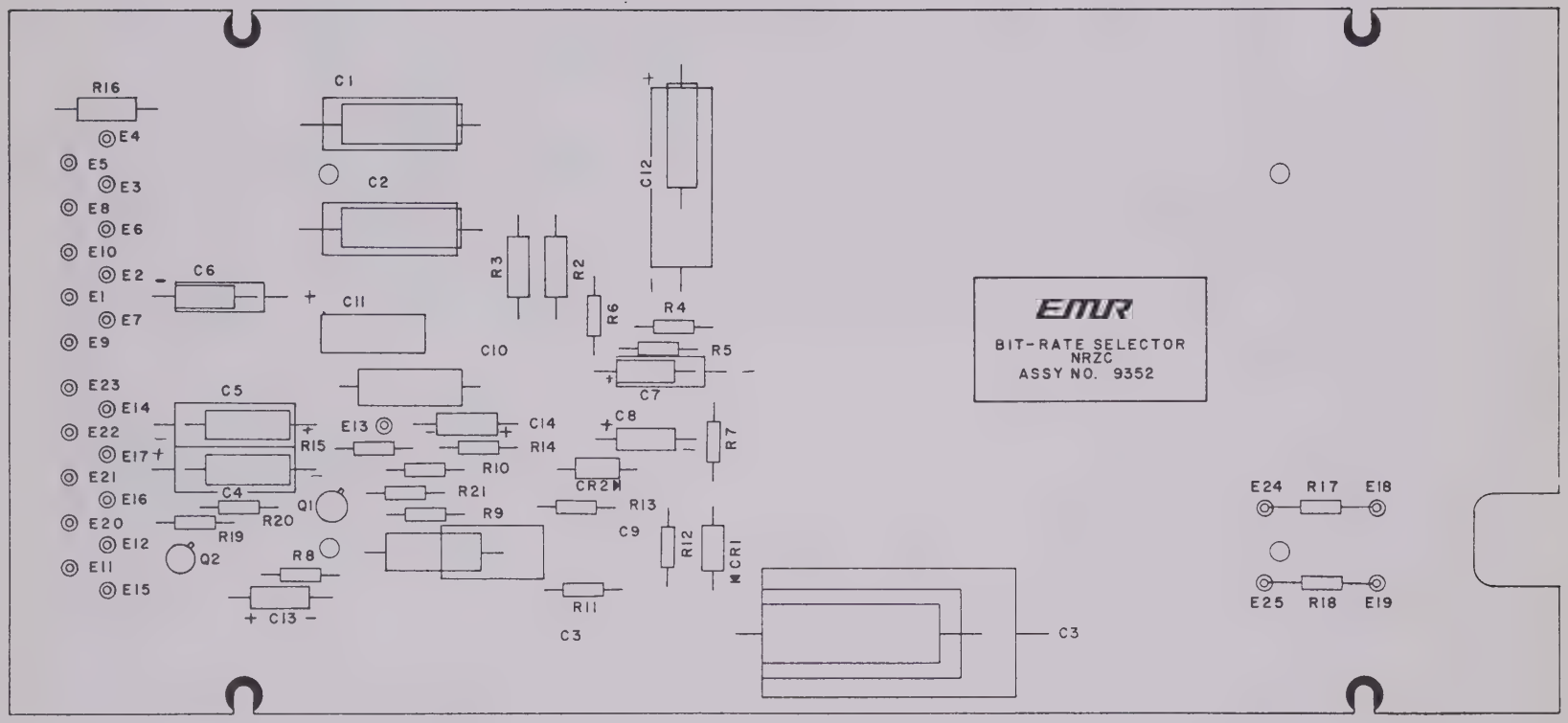
Figure 5-7. Regulator Card A6, Schematic Diagram



NOTE:

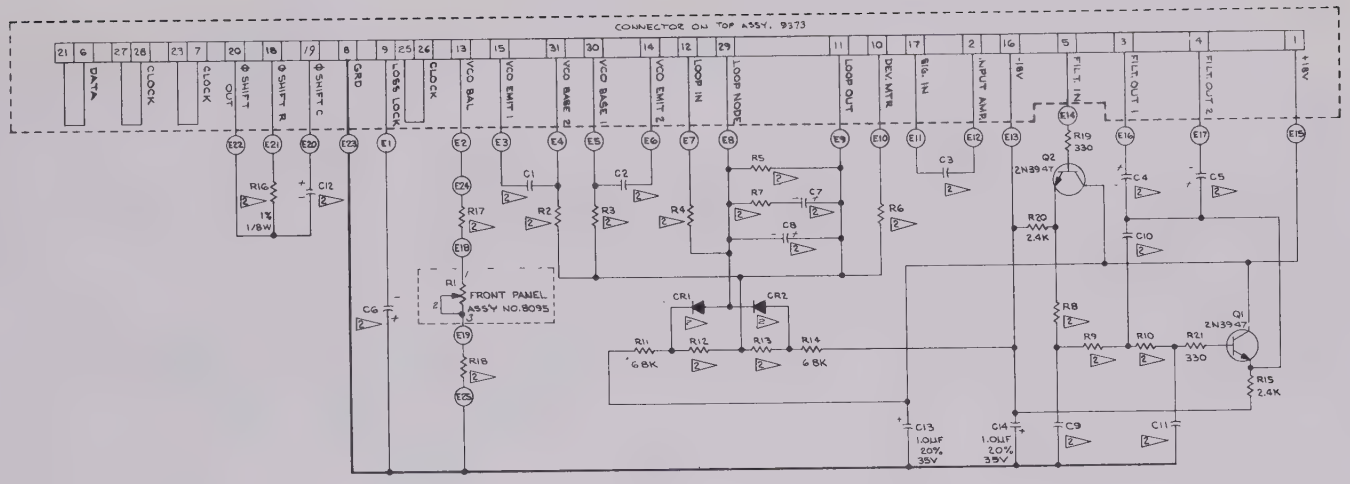
1. EMR DRAWING CONTROL NO. 2726-009.

Figure 5-8. Model 2727 Selector Module, Assembly Diagram



NOTE: EMR DWG. NO. 9352, REV. C

Figure 5-9. NRZC Selector Module Card A2, Location of Components



NOTES:

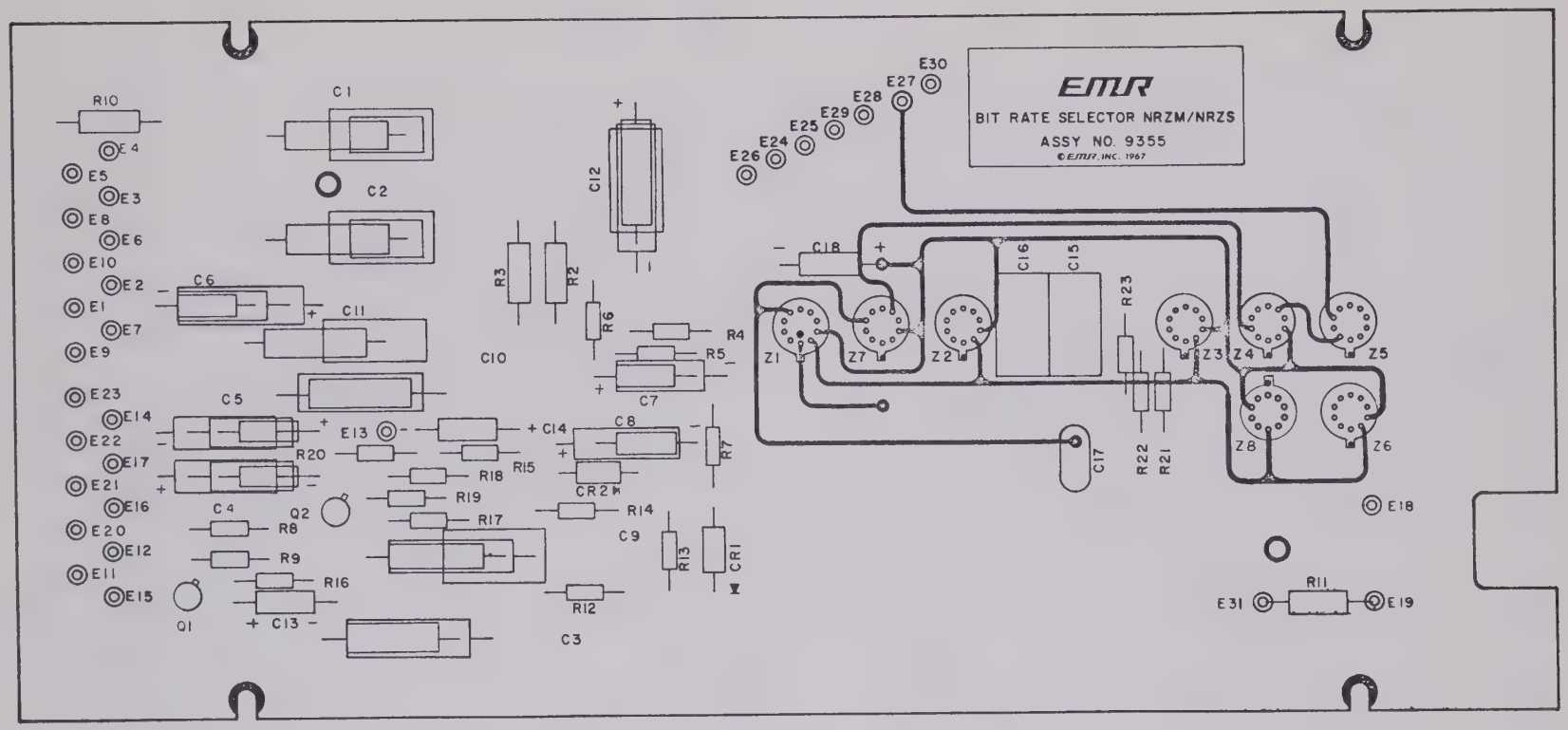
UNLESS OTHERWISE SPECIFIED:

1 ALL RESISTOR VALUES ARE IN OHMS (K=1000), 5%, 1/4 W.

2 POA VARIABLE, SEE VARIABLE CHART DRAWING 12007.

3 EMR DWG. NO. 9354, REV. E

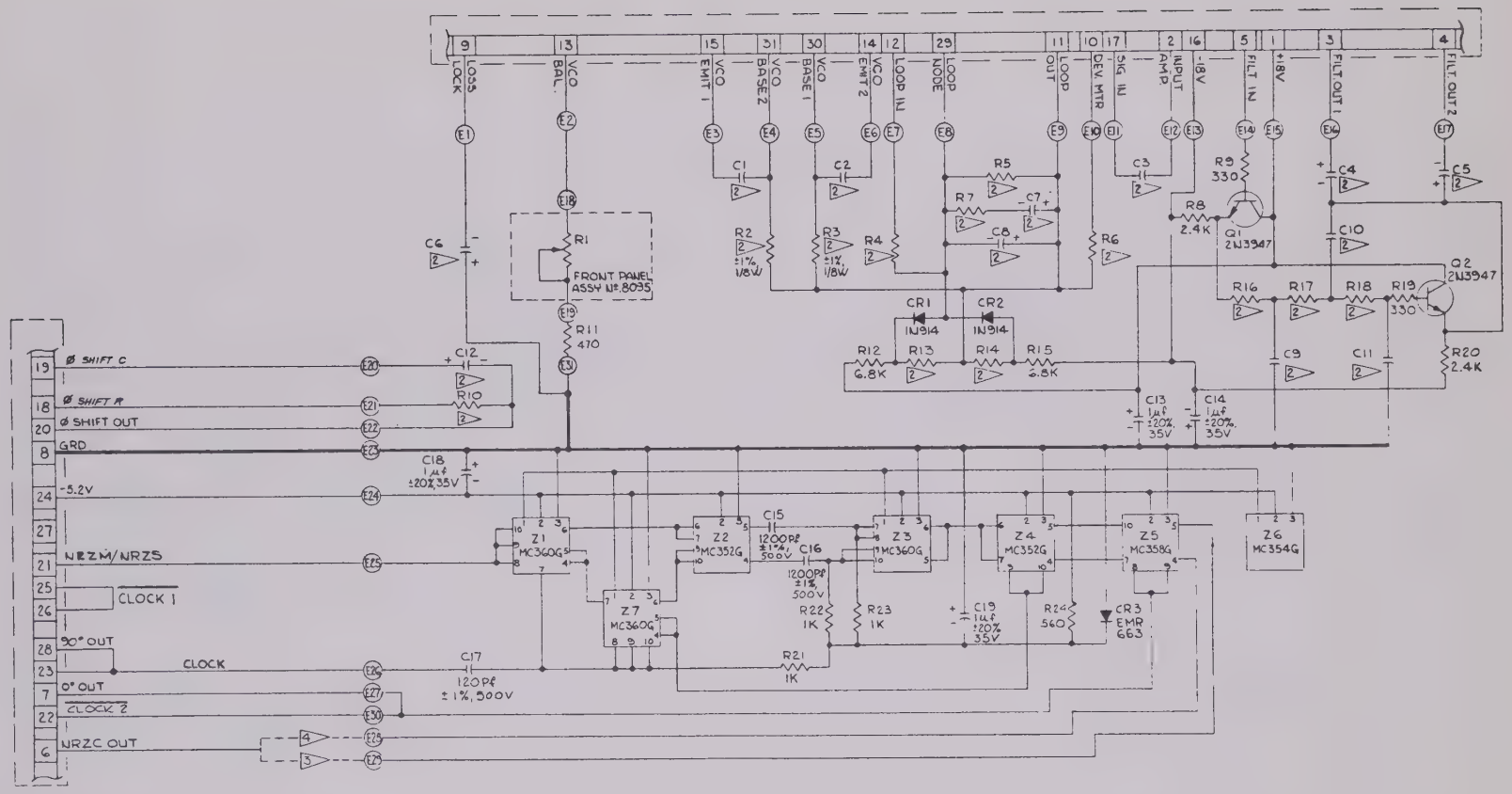
Figure 5-10. NRZC Selector Module Card A2 Schematic Diagram



NOTES:

1. EMR DWG NO. 9355, REV. C

Figure 5-11. NRZM/NRZS Selector Module Card A2, Location of Components

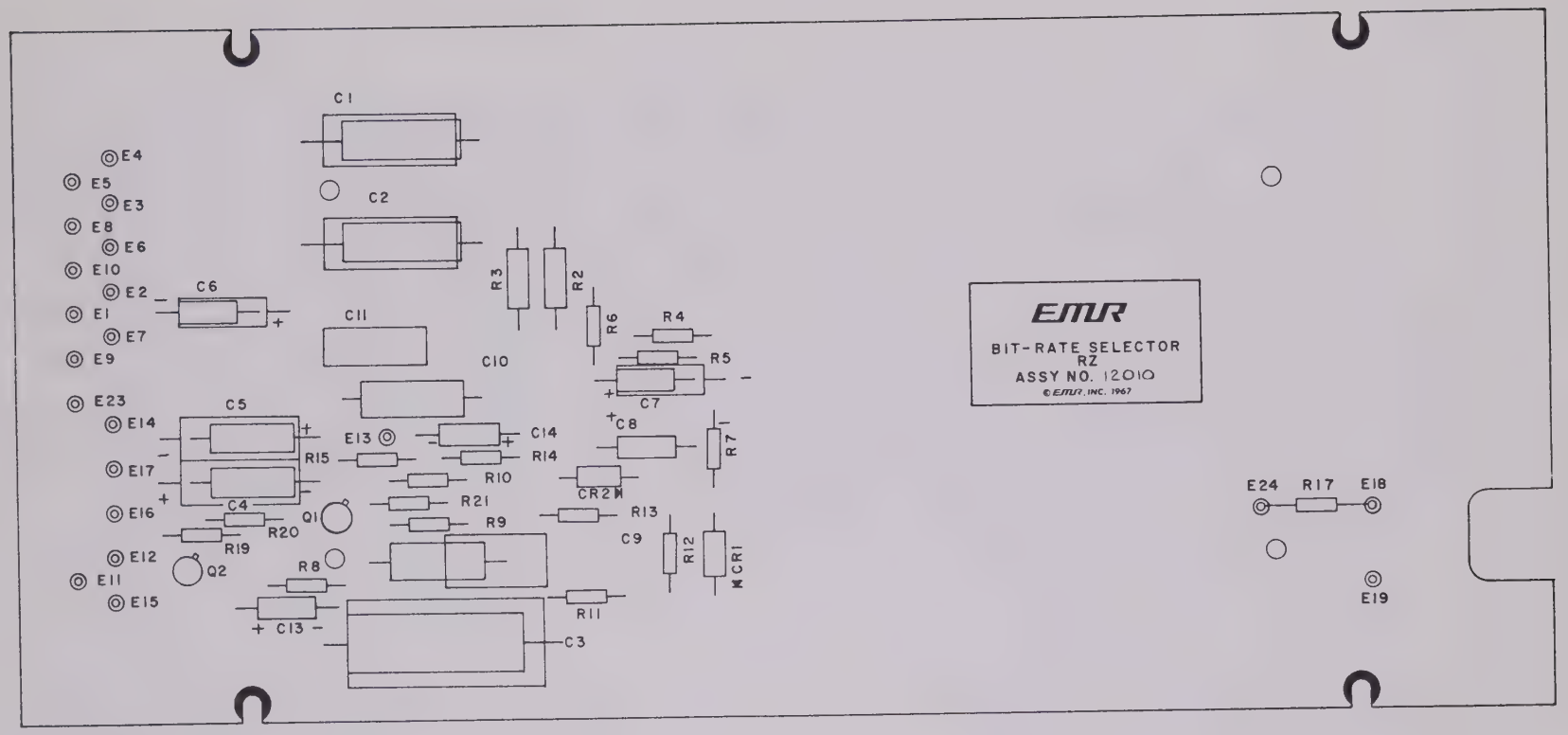


NOTES:

UNLESS OTHERWISE SPECIFIED:

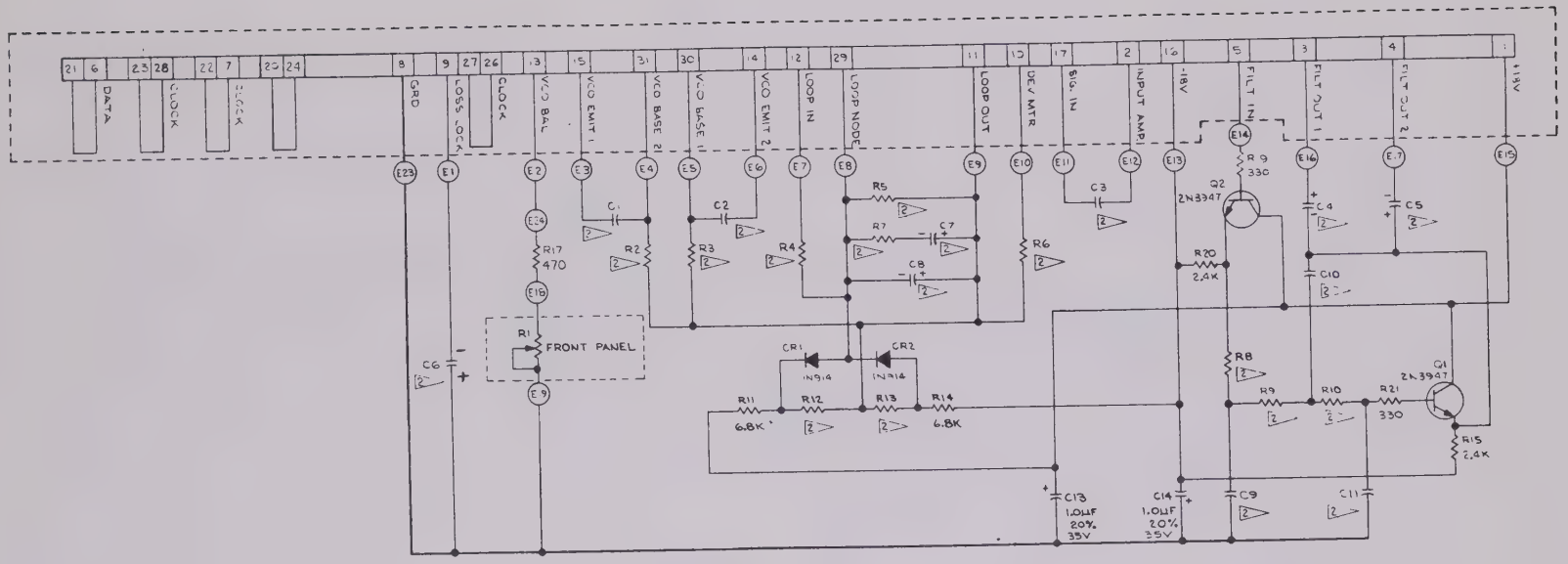
1. ALL RESISTOR VALUES ARE IN OHMS (K=1000), ±5%, 1/4W.
2. FACTORY ADJUSTMENT
3. FOR NRZM, CONNECT PIN 6 TO E 29.
4. FOR NRZS, CONNECT PIN 6 TO E 28.
5. EMR DWG NO 9357, REV. B

Figure 5-12. NRZM/NRZS Selector Module Card A2, Schematic Diagram



NOTE: EMR DWG. NO. 12010, REV. C

Figure 5-13. RZ Selector Module Card A2, Location of Components



NOTES:

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS (K=1000), 5%, 1/4 W.
2. VARIABLE COMPONENTS; SEE PARTS LIST FOR VALUE.
3. EMR DWG Nº 12008, REV. B

Figure 5-14. RZ Selector Module Card A2, Schematic Diagram

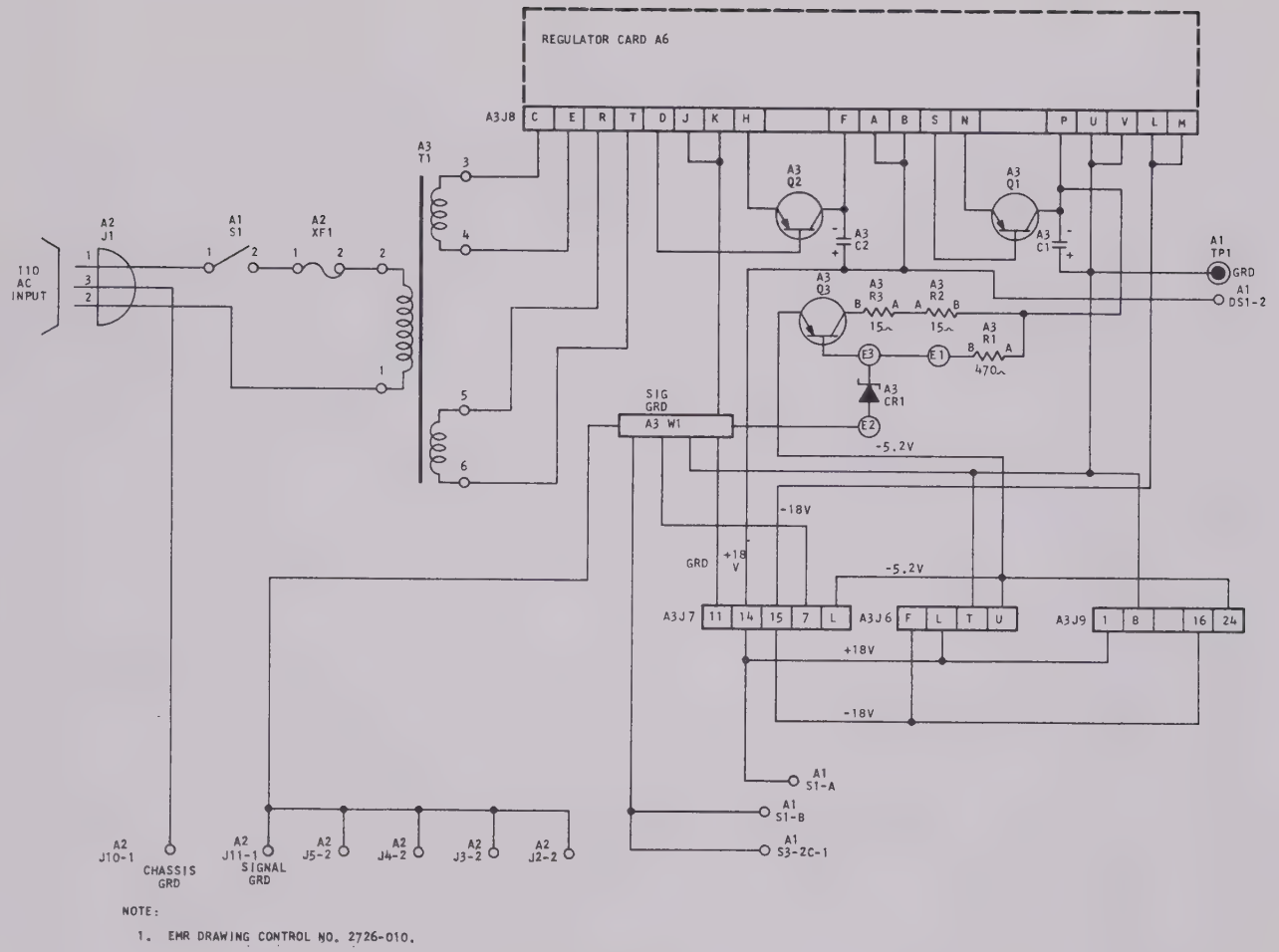


Figure 5-15. AC and DC Power Distribution Diagram

SECTION 6

PARTS LIST

6.1 GENERAL

This section contains information necessary to identify electronic components for the Model 2726-02 and -82 PCM Signal Conditioner and Model 2727 NRZC, NRZM, NRZS, and RZ Selector Modules. Parts information is presented in tabular form and is keyed to illustrations in other sections of this manual. Parts lists for the remaining selector modules are contained in appendices to this manual. These appendices will be supplied when the appropriate selector module is included in the signal conditioner.

Table 6-1. Model 2726 Signal Conditioner, Parts List (Ref. Figure 5-1)

CIRCUIT SYMBOL NO.	DESCRIPTION	MANUFACTURER	
		NAME	PART NO.
	MODEL 2726-02 AND -82 SIGNAL CONDITIONER ASSEMBLY	EMR	9340-1 (Rev. B)
A1	FRONT PANEL SUBASSEMBLY (Ref. Figure 3-2)	EMR	9340-1
DS1	RED DISPLAY LAMP	Eldema	CFW-22556-01
M1	METER	EMR	170-99-00003
M2	METER	EMR	170-99-00004
S1	SWITCH	Pendar	B507L256W1-L
S2 and S3	MODIFIED SWITCH	EMR	250-99-00012
TP1 thru TP4	TEST JACK	E. F. Johnson	105-253-1
XDS1	INDICATOR HOLDER	Eldema	10905-02
A2	REAR PANEL SUBASSEMBLY (Ref. Figure 3-1)	EMR	9340-1
F1	FUSE, 0.5 Amp, 250V	Littelfuse	312.500
J1	MODIFIED CONNECTOR	EMR	063-99-00012
J2 thru J5	CONNECTOR	MIL/STD	UG-1094A/U
J10	GROUNDED BINDING POST	Superior	GP-30NC
J11	BLACK BINDING POST	Superior	DF-30BC
XF1	FUSE HOLDER	Littelfuse	342004
A3	MAIN CHASSIS SUBASSEMBLY	EMR	9340-1
A3C1 and A3C2	CAPACITOR, 1800 μf −10% +75%, 40V	Sprague	36D182G040-AA6A
A3CR1	DIODE	EMR	088-99-00199
A3J6 and A3J7	CONNECTOR	Cinch	251-22-30-160
A3J8	CONNECTOR	Cinch	250-18-30-170
A3J9	CONNECTOR	Amphenol	26-159-32
A3Q1 thru A3Q3	TRANSISTOR	JEDEC	2N3740
A3R1	RESISTOR, 470Ω ±10%, 1W	Allen Bradley	RC32GF471K
A3R2 and A3R3	RESISTOR, 15Ω ±3%, 10W	Dale	PH-10-1
A3T1	TRANSFORMER, 115 VAC (Model 2726-02)	EMR	262-99-00042
A3T1	TRANSFORMER, 230 VAC (Model 2726-82)	EMR	262-99-00072
A4	SIGNAL CONDITIONER PRINTED-CIRCUIT CARD (See Table 6-2 for breakdown)	EMR	14922
A5	SYNCHRONIZER PRINTED-CIRCUIT CARD (See Table 6-3 for breakdown)	EMR	14847
A6	REGULATOR PRINTED-CIRCUIT CARD (See Table 6-4 for breakdown)	EMR	6332
	MODEL 2727 SELECTOR MODULE (See Table 6-5 for breakdown)	EMR	9373
	POWER CORD, 8-feet, with mating plugs	EMR	070-98-00016

Table 6-2. Signal Conditioner Printed-Circuit Card, Parts List (Ref. Figure 5-1)

CIRCUIT SYMBOL NO.	DESCRIPTION	MANUFACTURER	
		NAME	PART NO.
A4	SIGNAL CONDITIONER PRINTED-CIRCUIT CARD	EMR	14922
C1	CAPACITOR, 1 µf ±20%, 35V	EMR	336-23-10003
C2	CAPACITOR, 1000 Pf ±1%, 100V	EMR	304-62-10000
C3 and C4	CAPACITOR, 100 µf ±20%, 20V	EMR	339-22-10005
C5 thru C8	CAPACITOR, Same as C1		
C9	CAPACITOR, 120 Pf ±1%, 500V	EMR	304-20-12009
C10 and C11	CAPACITOR, 820 Pf ±1%, 300 V	EMR	304-41-82009
CR1 thru CR6	DIODE	EMR	088-99-00159
CR7	DIODE	JEDEC	1N4733
Q1 thru Q3	TRANSISTOR	JEDEC	2N3947
Q4 thru Q6	TRANSISTOR	JEDEC	2N3251
Q7	TRANSISTOR, Same as Q1		
R1	RESISTOR, 47Ω ±5%, 1/4W	Allen Bradley	RC07GF470J
R2	RESISTOR, 47K ±5%, 1/4W	Allen Bradley	RC07GF473J
R3	RESISTOR, Same as R1		
R4	RESISTOR, 10K ±5%, 1/4W	Allen Bradley	RC07GF103J
R5	RESISTOR, 40.2K ±1%, 1/8W	EMR	605-09-40201
R6	RESISTOR, 121K ±1%, 1/8W	EMR	605-09-12102
R7	RESISTOR, 2.4K ±5%, 1/4W	Allen Bradley	RC07GF242J
R8	RESISTOR, 330Ω ±5%, 1/4W	Allen Bradley	RC07GF331J
R9	RESISTOR, 100Ω ±5%, 1/4W	Allen Bradley	RC07GF101J
R10 and R11	RESISTOR, Same as R8		
R12	RESISTOR, Same as R7		
R13	RESISTOR, Same as R8		
R14 and R15	RESISTOR, 10K ±1%, 1/8W	EMR	605-09-10001
R16	RESISTOR, 51K ±5%, 1/4W	Allen Bradley	RC07GF513J
R17	RESISTOR, Same as R9		
R18	POTENTIOMETER, 25K ±10%, 1/4W	Clarostat	63M5
R19	RESISTOR, Same as R1		
R20	RESISTOR, 150K ±5%, 1/4W	Allen Bradley	RC07GF154J
R21	RESISTOR, Same as R1		
R22	RESISTOR, Same as R2		
R23	RESISTOR, Same as R1		
R24	RESISTOR, Same as R4		
R25	RESISTOR, 4.7K ±5%, 1/4W	Allen Bradley	RC07GF472J
R26	RESISTOR, 1.5K ±5%, 1/4W	Allen Bradley	RC07GF152J
R27	RESISTOR, Same as R7		
R28 and R29	RESISTOR, 100K ±5%, 1/4W	Allen Bradley	RC07GF104J
R30	RESISTOR, 360Ω ±5%, 1/4W	Allen Bradley	RC07GF361J
R31	RESISTOR, 91Ω ±5%, 1/4W	Allen Bradley	RC07GF910J
R32	RESISTOR, 100Ω ±3%, 6.5W	EMR	630-03-10009
R33	RESISTOR, 2.2K ±5%, 1/4W	Allen Bradley	RC07GF222J
R34	POTENTIOMETER, 500Ω ±10%, 1/4W	Clarostat	63M5
R35	RESISTOR, 560Ω ±5%, 1/4W	Allen Bradley	RC07GF561J
R36	RESISTOR, 1K ±5%, 1/4W	Allen Bradley	RC07GF102J
R37 thru R40	RESISTOR, 2K ±5%, 1/4W	Allen Bradley	RC07GF202J
R41	RESISTOR, 270Ω ±5%, 1/4W	Allen Bradley	RC07GF271J
R42 and R43	RESISTOR, 100Ω ±5%, 1/4W	Allen Bradley	RC07GF101J
TP1 and TP2	JACK, Test, Black	E.F. Johnson	105-853
Z1 and Z2	INTEGRATED CIRCUIT MODULE	Motorola	MC 356G
Z3	INTEGRATED CIRCUIT MODULE	Motorola	MC 360G
Z4	INTEGRATED CIRCUIT MODULE	Motorola	MC 352G
Z5	INTEGRATED CIRCUIT MODULE, Same as Z3		
Z6 thru Z8	INTEGRATED CIRCUIT MODULE, Same as Z1		
R—	Resistor 10K ±5% 1/4W		

Table 6-2. Signal Conditioner Printed-Circuit Card, Parts List (Ref. Figure 5-1)

CIRCUIT SYMBOL NO.	DESCRIPTION	MANUFACTURER	
		NAME	PART NO.
A4	SIGNAL CONDITIONER PRINTED-CIRCUIT CARD	EMR	14922
C1	CAPACITOR, 1 µf ±20%, 35V	EMR	336-23-10003
C2	CAPACITOR, 1000 Pf ±1%, 100V	EMR	304-62-10000
C3 and C4	CAPACITOR, 100 µf ±20%, 20V	EMR	339-22-10005
C5 thru C8	CAPACITOR, Same as C1		
C9	CAPACITOR, 120 Pf ±1%, 500V	EMR	304-20-12009
C10 and C11	CAPACITOR, 820 Pf ±1%, 300 V	EMR	304-41-82009
CR1 thru CR6	DIODE	EMR	088-99-00159
CR7	DIODE	JEDEC	1N4733
Q1 thru Q3	TRANSISTOR	JEDEC	2N3947
Q4 thru Q6	TRANSISTOR	JEDEC	2N3251
Q7	TRANSISTOR, Same as Q1		
R1	RESISTOR, 47Ω ±5%, 1/4W	Allen Bradley	RC07GF470J
R2	RESISTOR, 47K ±5%, 1/4W	Allen Bradley	RC07GF473J
R3	RESISTOR, Same as R1		
R4	RESISTOR, 10K ±5%, 1/4W	Allen Bradley	RC07GF103J
R5	RESISTOR, 40.2K ±1%, 1/8W	EMR	605-09-40201
R6	RESISTOR, 121K ±1%, 1/8W	EMR	605-09-12102
R7	RESISTOR, 2.4K ±5%, 1/4W	Allen Bradley	RC07GF242J
R8	RESISTOR, 330Ω ±5%, 1/4W	Allen Bradley	RC07GF331J
R9	RESISTOR, 100Ω ±5%, 1/4W	Allen Bradley	RC07GF101J
R10 and R11	RESISTOR, Same as R8		
R12	RESISTOR, Same as R7		
R13	RESISTOR, Same as R8		
R14 and R15	RESISTOR, 10K ±1%, 1/8W	EMR	605-09-10001
R16	RESISTOR, 51K ±5%, 1/4W	Allen Bradley	RC07GF513J
R17	RESISTOR, Same as R9		
R18	POTENTIOMETER, 25K ±10%, 1/4W	Clarostat	63M5
R19	RESISTOR, Same as R1		
R20	RESISTOR, 150K ±5%, 1/4W	Allen Bradley	RC07GF154J
R21	RESISTOR, Same as R1		
R22	RESISTOR, Same as R2		
R23	RESISTOR, Same as R1		
R24	RESISTOR, Same as R4		
R25	RESISTOR, 4.7K ±5%, 1/4W	Allen Bradley	RC07GF472J
R26	RESISTOR, 1.5K ±5%, 1/4W	Allen Bradley	RC07GF152J
R27	RESISTOR, Same as R7		
R28 and R29	RESISTOR, 100K ±5%, 1/4W	Allen Bradley	RC07GF104J
R30	RESISTOR, 360Ω ±5%, 1/4W	Allen Bradley	RC07GF361J
R31	RESISTOR, 91Ω ±5%, 1/4W	Allen Bradley	RC07GF910J
R32	RESISTOR, 100Ω ±3%, 6.5W	EMR	630-03-10009
R33	RESISTOR, 2.2K ±5%, 1/4W	Allen Bradley	RC07GF222J
R34	POTENTIOMETER, 500Ω ±10%, 1/4W	Clarostat	63M5
R35	RESISTOR, 560Ω ±5%, 1/4W	Allen Bradley	RC07GF561J
R36	RESISTOR, 1K ±5%, 1/4W	Allen Bradley	RC07GF102J
R37 thru R40	RESISTOR, 2K ±5%, 1/4W	Allen Bradley	RC07GF202J
R41	RESISTOR, 270Ω ±5%, 1/4W	Allen Bradley	RC07GF271J
R42 and R43	RESISTOR, 100Ω ±5%, 1/4W	Allen Bradley	RC07GF101J
TP1 and TP2	JACK, Test, Black	E.F. Johnson	105-853
Z1 and Z2	INTEGRATED CIRCUIT MODULE	Motorola	MC 356G
Z3	INTEGRATED CIRCUIT MODULE	Motorola	MC 360G
Z4	INTEGRATED CIRCUIT MODULE	Motorola	MC 352G
Z5	INTEGRATED CIRCUIT MODULE, Same as Z3		
Z6 thru Z8	INTEGRATED CIRCUIT MODULE, Same as Z1		

Table 6-2 (Cont'd.). Signal Conditioner Printed-Circuit Card, Parts List (Ref. Figure 5-2)

CIRCUIT SYMBOL NO.	DESCRIPTION	MANUFACTURER	
		NAME	PART NO.
Z9	INTEGRATED CIRCUIT MODULE	Motorola	MC 354G
Z10 thru Z12	INTEGRATED CIRCUIT MODULE	Motorola	MC 367G
Z13 and Z14	INTEGRATED CIRCUIT MODULE	Sylvania	SG-~~133-03~~ 42-53

Table 6-3. Synchronizer Printed-Circuit Card, Parts List (Ref. Figure 5-4)

CIRCUIT SYMBOL NO.	DESCRIPTION	MANUFACTURER	
		NAME	PART NO.
A5	SYNCHRONIZER PRINTED-CIRCUIT CARD	EMR	14847
C1 and C2	CAPACITOR, 1 μf ±20%, 35V	EMR	336-23-10003
C3	CAPACITOR, .0047 μf ±10%, 35V	EMR	336-14-47000
C4	CAPACITOR, Same as C1		
C5	CAPACITOR, Same as C3		
C6	CAPACITOR, Same as C1		
C7 and C8	CAPACITOR, 200 Pf ±1%, 500V	EMR	304-20-20009
C9 thru C14	CAPACITOR, Same as C1		
CR1 and CR2	DIODE	EMR	088-99-00259
CR3 thru CR7	DIODE	EMR	088-99-00159
Q1	TRANSISTOR	JEDEC	2N3566
Q2	TRANSISTOR	JEDEC	2N3947
Q3	TRANSISTOR	JEDEC	2N3251
Q4 and Q5	TRANSISTOR	JEDEC	2N2501
Q6	TRANSISTOR, Same as Q3		
Q7 and Q8	TRANSISTOR	JEDEC	2N3638
R1	RESISTOR, 180Ω ±10%, 1W	Allen Bradley	RC07GF181K
R2	RESISTOR, 2.4K ±5%, 1/4W	Allen Bradley	RC07GF242J
R3	RESISTOR, 1.5K ±5%, 1/4W	Allen Bradley	RC07GF152J
R4	RESISTOR, 2.2K ±5%, 1/4W	Allen Bradley	RC07GF222J
R5	POTENTIOMETER, 10K ±20%, 1/3W	Allen Bradley	NP103M
R7 and R8	RESISTOR, Same as R3		
R9	POTENTIOMETER, 500Ω ±20%, 1/3W	Allen Bradley	NP501M
R10	RESISTOR, Same as R3		
R11	RESISTOR, 4.7K ±5%, 1/4W	Allen Bradley	RC07GF472J
R12	RESISTOR, 10K ±5%, 1/4W	Allen Bradley	RC07GF103J
R13	RESISTOR, Same as R1		
R14	RESISTOR, 5.1K ±5%, 1/4W	Allen Bradley	RC07GF512J
R15	RESISTOR, 360Ω ±5%, 1/4W	Allen Bradley	RC07GF361J
R16	RESISTOR, 1K ±5%, 1/4W	Allen Bradley	RC07GF102J
R17	RESISTOR, Same as R15		
R18	RESISTOR, Same as R14		
R19	RESISTOR, Same as R16		
R20	RESISTOR, 1.2K ±5%, 1/4W	Allen Bradley	RC07GF122J
R21	RESISTOR, 1.6K ±5%, 1/4W	Allen Bradley	RC07GF162J
R22	RESISTOR, Same as R17		
R23	RESISTOR, Same as R21		
R24 and R25	RESISTOR, Same as R16		
R26	RESISTOR, 51Ω ±5%, 1/4W	Allen Bradley	RC07GF510J
TP1	JACK, Test Black	E.F. Johnson	105-853
TP2	JACK, Test White	E.F. Johnson	105-851
Z1 and Z2	INTEGRATED CIRCUIT MODULE	Motorola	MC356G
Z3	INTEGRATED CIRCUIT MODULE	Motorola	MC360G
Z4 and Z5	INTEGRATED CIRCUIT MODULE, Same as Z3		
Z6 and Z7	INTEGRATED CIRCUIT MODULE,	Motorola	MA709C
Z8	INTEGRATED CIRCUIT MODULE	Motorola	MC352G
Z9	INTEGRATED CIRCUIT MODULE, Same as Z3		
Z10	INTEGRATED CIRCUIT MODULE	Motorola	MC358G/SC1322 A
Z11	INTEGRATED CIRCUIT MODULE	Motorola	MC365G
Z12 and Z13	INTEGRATED CIRCUIT MODULE, Same as Z1		
Z14	INTEGRATED CIRCUIT MODULE, Same as Z3		
Z15	INTEGRATED CIRCUIT	Motorola	MC354G

Table 6-4. Regulator Printed-Circuit Card, Parts List (Ref. Figure 5-6)

Revised See Drawing Notice 5 Sheet 3 & 4

CIRCUIT SYMBOL NO.	DESCRIPTION	MANUFACTURER	
		NAME	PART NO.
A6	REGULATOR PRINTED-CIRCUIT CARD	EMR	6332
C1	CAPACITOR, 0.01 µf ±10%, 100V	EMR	361-01-10001
C2	CAPACITOR, 47 µf ±20%, 35V	EMR	339-23-47004
C3	CAPACITOR, Same as C1		
C4	CAPACITOR, Same as C2		
CR1	DIODE	Motorola	SDA 10084
CR2 thru CR4	DIODE	EMR	088-99-00169
CR5	DIODE	JEDEC	1N936B
CR6	DIODE, Same as CR1		
CR7 thru CR9	DIODE, Same as CR2		
CR10	DIODE, Same as CR5		
Q1	TRANSISTOR	EMR	263-99-00259
Q2	TRANSISTOR	JEDEC	2N3638
Q3	TRANSISTOR	JEDEC	2N3565
Q4 and Q5	TRANSISTOR, Same as Q2		
Q6	TRANSISTOR, Same as Q1		
Q7	TRANSISTOR, Same as Q2		
Q8	TRANSISTOR, Same as Q3		
Q9 and Q10	TRANSISTOR, Same as Q2		
R1	RESISTOR, 47Ω ±5%, 1/4W	Allen Bradley	RC07GF470J
R2	RESISTOR, 2Ω ±3%, 3W	Sage	1300S2-3
R3	RESISTOR, 1.2K ±5%, 1/4W	Allen Bradley	RC07GF122J
R4	RESISTOR, 150Ω ±5%, 1/4W	Allen Bradley	RC07GF151J
R5	RESISTOR, ~~909Ω~~ ±1%, 1/8W 604.5	EMR	605-09-90909
R6	RESISTOR, 220Ω ±5%, 1/4W	Allen Bradley	RC07GF221J
R7 and R8	RESISTOR, 4.7K ±5%, 1/4W	Allen Bradley	RC07GF472J
R9	RESISTOR, 12Ω ±5%, 1/4W	Allen Bradley	RC07GF120J
R10	POTENTIOMETER, 100Ω ±10%, 1/4W	Clarostat	63M5
R11	RESISTOR, 1.5K ±5%, 1/4W	Allen Bradley	RC07GF152J
R12	RESISTOR, Same as R5		
R13	RESISTOR, Same as R1		
R14	RESISTOR, Same as R2		
R15	RESISTOR, Same as R3		
R16	RESISTOR, Same as R4		
R17	RESISTOR, Same as R5		
R18	RESISTOR, Same as R6		
R19 and R20	RESISTOR, Same as R7		
R21	RESISTOR, Same as R9		
R22	POTENTIOMETER, Same as R10		
R23	RESISTOR, Same as R11		
R24	RESISTOR, Same as R5		
TP1	JACK, Test, Violet	E.F. Johnson	105-862
TP2	JACK, Test, Black	E.F. Johnson	105-853
TP3	JACK, Test, Red	E.F. Johnson	105-852

Table 6-5. Model 2727 Selector Module, Parts List (Ref. Figure 5-8)

CIRCUIT SYMBOL NO.	DESCRIPTION	MANUFACTURER	
		NAME	PART NO.
	MODEL 2727 SELECTOR MODULE	EMR	9373
A1	FRONT PANEL	EMR	8095
A1R1	POTENTIOMETER, 500Ω ±10%, 1/2W	EMR	636-01-50009
A2	PRINTED-CIRCUIT CARD (Used in Model 2727-01 NRZC Selector Module only; see Table 6-6 for breakdown)	EMR	9352
A2	PRINTED-CIRCUIT CARD (Used in Models 2727-02 and 2727-03 NRZM and NRZS Selector Modules only; see Table 6-7 for breakdown)	EMR	9355
A2	PRINTED-CIRCUIT CARD (Used in Model 2727-07 RZ Selector Module only; see Table 6-8 for breakdown)	EMR	12010
A3J1	REAR CONNECTOR	Amphenol	26-190-32

Table 6-6. NRZC Printed-Circuit Card, Parts List, (Ref. Figure 5-9)

CIRCUIT SYMBOL NO.	DESCRIPTION	MANUFACTURER	
		NAME	PART NO.
A2	NRZC PRINTED-CIRCUIT CARD (Used in Model 2727-01 Selector Module only)	EMR	9352
C1 thru C12	CAPACITOR (Factory adjustment per selector module parameters)		
C13 and C14	CAPACITOR, 1 μf ±20%, 35V	EMR	336-23-10003
CR1 and CR2	DIODE, (POA VAR)	EMR	12007
Q1 and Q2	TRANSISTOR	JEDEC	2N3947
R2 thru R10	RESISTOR (Factory adjustment per selector module parameters)		
R11	RESISTOR, 6.8K ±5%, 1/4W	Allen Bradley	RC07GF682J
R12 and R13	RESISTOR, Same as R2		
R14	RESISTOR, Same as R11		
R15	RESISTOR, 2.4K ±5%, 1/4W	Allen Bradley	RC07GF242J
R16 thru R18	RESISTOR, Same as R2		
R19	RESISTOR, 330Ω ±5%, 1/4W	Allen Bradley	RC07GF331J
R20	RESISTOR, Same as R15		
R21	RESISTOR, Same as R19		

Table 6-7. NRZM and NRZS Printed-Circuit Card, Parts List (Ref. Figure 5-11)

CIRCUIT SYMBOL NO.	DESCRIPTION	MANUFACTURER	
		NAME	PART NO.
A2	NRZM AND NRZS PRINTED-CIRCUIT CARD (Used in Models 2727-02 and 2727-03 Selector Modules only)	EMR	9355
C1 thru C12	CAPACITOR (Factory adjustment per selector module parameters)		
C13 and C14	CAPACITOR, 1 μf ±20%, 35V	EMR	336-23-10003
C15 and C16	CAPACITOR, 1200 Pf±1%, 500V	EMR	305-20-12000
C17	CAPACITOR, 120 Pf±1%, 500V	EMR	304-20-12009
C18	CAPACITOR, Same as C13		
CR1 and CR2	DIODE	EMR	088-99-00159
Q1 and Q2	TRANSISTOR	JEDEC	2N3947
R2 thru R7	RESISTOR (Factory adjustment per selector module parameters)		
R8	RESISTOR, 2.4K ±5%, 1/4W	Allen Bradley	RC07GF242J
R9	RESISTOR, 330Ω ±5%, 1/4W	Allen Bradley	RC07GF331J
R10	RESISTOR, Same as R2		
R11	RESISTOR, 470Ω ±5%, 1/4W	Allen Bradley	RC07GF471J
R12	RESISTOR, 6.8K ±5%, 1/4W	Allen Bradley	RC07GF682J
R13 and R14	RESISTOR, Same as R2		
R15	RESISTOR, Same as R12		
R16 thru R18	RESISTOR, Same as R2		
R19	RESISTOR, Same as R9		
R20	RESISTOR, Same as R8		
R21 thru R23	RESISTOR, 1K ±5%, 1/4W	Allen Bradley	RC07GF102J
Z1	INTEGRATED CIRCUIT MODULE	Motorola	MC 360G
Z2	INTEGRATED CIRCUIT MODULE	Motorola	MC 352G
Z3	INTEGRATED CIRCUIT MODULE, Same as Z1		
Z4	INTEGRATED CIRCUIT MODULE, Same as Z2		
Z5	INTEGRATED CIRCUIT MODULE	Motorola	MC 358G
Z6	INTEGRATED CIRCUIT MODULE	Motorola	MC 354G
Z7	INTEGRATED CIRCUIT MODULE, Same as Z1		
Z8	INTEGRATED CIRCUIT MODULE	Motorola	MC 356G

Table 6-8. RZ Printed-Circuit Card, Parts List (Ref. Figure 5-13)

CIRCUIT SYMBOL NO.	DESCRIPTION	MANUFACTURER	
		NAME	PART NO.
A2	RZ PRINTED-CIRCUIT CARD (Used in Model 2727-07 Selector Module Only)	EMR	12010
C1 thru C11	CAPACITOR (Factory adjustment per selector module parameters)		
C13 and C14	CAPACITOR, 1 μf ±20%, 35V	EMR	336-23-10003
CR1 and CR2	DIODE	EMR	088-99-00159
Q1 and Q2	TRANSISTOR	JEDEC	2N3947
R2 thru R10	RESISTOR (Factory adjustment per selector module parameters)		
R11	RESISTOR, 6.8K ±5%, 1/4W	Allen Bradley	RC07GF682J
R12 and R13	RESISTOR, Same as R2		
R14	RESISTOR, Same as R11		
R15	RESISTOR, 2.4K ±5%, 1/4W	Allen Bradley	RC07GF242J
R17	RESISTOR, 470Ω ±5%, 1/4W	Allen Bradley	RC07GF471J
R19	RESISTOR, 330Ω ±5%, 1/4W	Allen Bradley	RC07GF331J
R20	RESISTOR, Same as R15		
R21	RESISTOR, Same as R19		

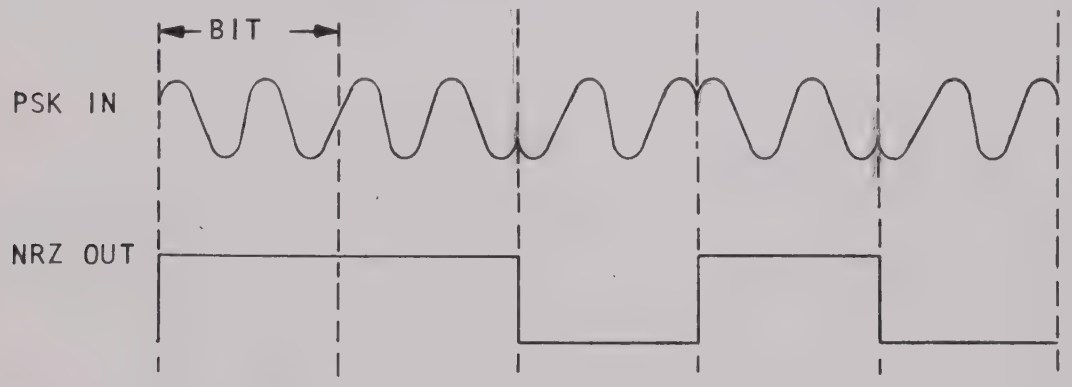
APPENDIX D-10
EMR MODEL 2726/2727-10 PSK DEMODULATOR
(REVISION B)

D.1 GENERAL

The EMR Model 2726/2727-10 PSK (phase-shift-keyed) Demodulator performs the conversion of a serial PSK signal into an equivalent serial NRZ (non-return-to-zero) output. Included in the PSK Demodulator are a standard EMR Model 2726-02 PCM Signal Conditioner chassis and a specially designed Model 2727-10 Plug-In PSK Selector Module. The physical characteristics of these units are identical to the Model 2726/2727 PCM Signal Conditioner described in Section 1 of the associated instruction manual. A functional description of the PSK Demodulator and telemetry system application is provided in paragraphs D.2 and D.3. Installation and operation, theory of operation, adjustment procedure, drawings, and replaceable parts lists are contained in paragraphs D.4 through D.8, respectively.

D.2 FUNCTIONAL DESCRIPTION

The PSK Demodulator accepts a serial PSK input and synchronously converts this input into a PCM output signal coded NRZ. An example of a typical PSK input and resultant NRZ output is shown in the following diagram.



A PSK telemetry signal is a carrier wavetrain with the modulation component contained in the phase of the carrier on a bit-by-bit basis. The incoming waveform shown is a coherent PSK signal which contains an identical number of complete carrier cycles for each bit location. Although only two cycles per bit are used in the example, any number of complete carrier cycles may be used to represent a bit location. A non-coherent PSK signal contains fractional parts of carrier cycles per bit location, such as 4-1/2. The PSK Demodulator will operate from either type of input signal as long as the spacing is the same on a bit-by-bit basis.

The resultant NRZ output may be coded NRZ type C, M, or S, depending on the coding parameters at the signal source. The NRZ code, however, is not significant for operation of the PSK Demodulator. The significant parameter for operation is the carrier frequency.

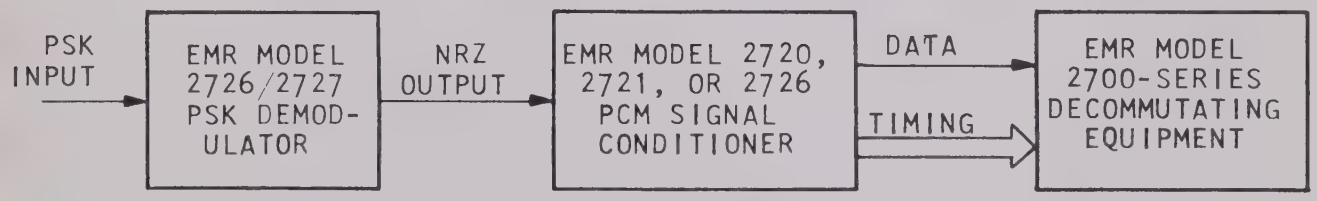
Each PSK Selector Module is designed for operation at a specified carrier frequency. This frequency is identified on the plug-in selector module front panel. All frequency determining components for the PSK Demodulator are contained in the plug-in selector module. The Model 2726 chassis is standardized for operation at any carrier frequency established by the plug-in selector module.

Outputs available from the PSK Demodulator include the serial NRZ data, a synchronization output, and a conditioned PSK output. The serial NRZ data is available at rear panel OUTPUT connector J5. The synchronization output is available at connector J3. Although this connector is marked 0° SYNC, this is not necessarily true for the PSK Demodulator. The conditioned PSK output is available at rear panel connector J4 (marked 90° SYNC). The conditioned PSK output is typically used for magnetic tape recording purposes.

D.3 TELEMETRY SYSTEM APPLICATION

The PSK Demodulator operates as an interface unit between a PSK signal source and a PCM signal conditioning unit. Inputs to the PSK Demodulator may be derived from an RF link or magnetic tape recorder.

The NRZ output is a serial PCM signal requiring further signal conditioning and bit synchronization before decoding the PCM data contained in the signal. A typical system configuration for the PSK Demodulator is shown in the following diagram.



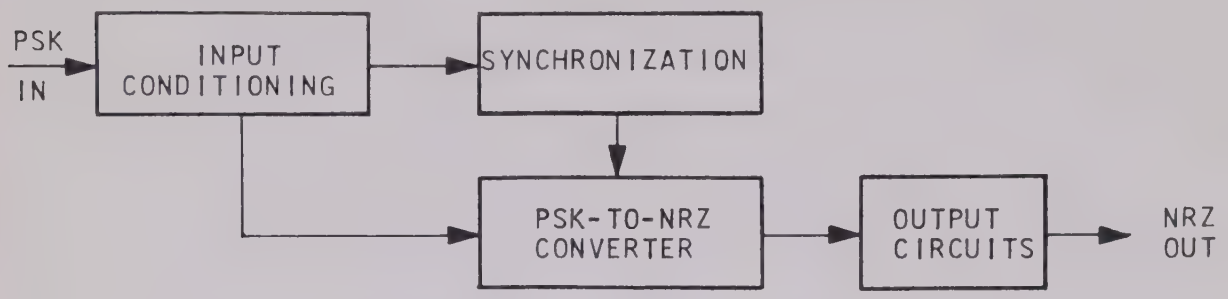
D.4 INSTALLATION AND OPERATION

The PSK Demodulator is installed and operated as described in Section 3 of this manual except for the type of outputs available at the rear panel connectors. These outputs are described in paragraph D.2.

D.5 THEORY OF OPERATION

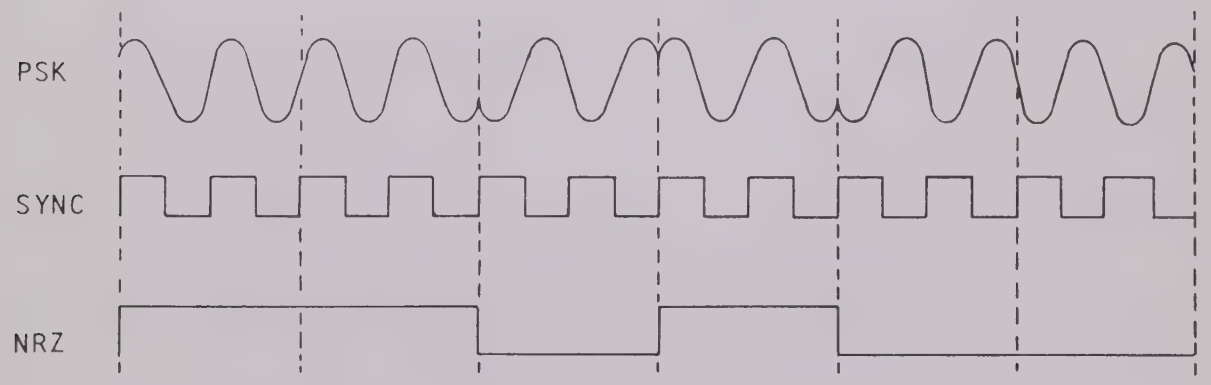
The PSK Demodulator theory of operation is discussed at the system level with reference to the simplified diagrams provided. Certain circuits of the PSK Demodulator are identical to circuits described in the associated instruction manual. The only circuits of the Model 2726 Signal Conditioner affected are the circuits contained in the PSK Selector Module. Detailed diagrams illustrating the circuits of the PSK Selector Module are described in paragraph D.7.

The PSK Demodulator contains four basic circuits which convert the PSK input signal into an NRZ output. These circuits are illustrated in the following diagram.



The input conditioning circuits isolate the internal circuitry from the signal source devices and attenuate the input signal to the level necessary for operation of the unit. Outputs from the input conditioning circuits are used in the generation of synchronization signals and in the PSK-to-NRZ conversion.

The synchronization circuits generate a squarewave output operating at the carrier frequency of the PSK input. This output is then compared with the conditioned PSK signal in the PSK-to-NRZ converter. The PSK-to-NRZ converter is essentially an exclusive OR function which removes the PSK carrier leaving only the modulation component. A typical example of the PSK-to-NRZ conversion is shown in the following waveforms:



In an exclusive OR function, the result of the comparison will yield a particular level when the two signals are of the same polarity and will yield the opposite level when the two signals are of the opposite polarity.

The method for the generation and control of the sync signal is identical to that described in paragraph 4.3.2 of the associated instruction manual except that the VCO is set to operate at twice the carrier frequency of the incoming PSK signal.

Other functional circuits of the PSK Demodulator include a meter drive circuit, output circuit, and power supply/regulator circuit. These circuits are described in paragraphs 4.3.1, 4.3.4, and 4.3.5 of the associated instruction manual.

An overall block diagram of the PSK Demodulator is shown in Figure D-1. This diagram should be used in conjunction with the detailed block diagram/ wiring diagram shown in Figure D-5.

D.6 ADJUSTMENT PROCEDURE

a. Using an external PSK carrier generator, apply an unmodulated carrier of 1.0-volt peak-to-peak input signal to rear panel A2J2. The frequency of the carrier should correspond to the established frequency of the selector module.

b. Position signal conditioner front-panel controls as follows:

   1. POWER switch to ON.

   2. RANGE switch to 10V.

   3. POLARITY switch to NORM.

c. Using an oscilloscope, monitor A4TP2 (signal conditioner card) and adjust A4R18 for a symmetrical square-wave indication.

d. Using an oscilloscope, monitor A4TP1 and adjust A4R34 for a symmetrical square-wave indication.

e. Install a clip-lead between A5TP1 (synchronizer card) and A5TP2.

f. Adjust A5R9 for an approximate center-scale indication (slightly positive for most units) on the DEV meter. Remove the TP1-TP2 clip-lead.

g. Temporarily disconnect the PSK carrier input to the unit.

h. Adjust A5R5 until the front-panel LOSS LOCK indicator just illuminates.

i. Using a DC voltmeter, monitor selector module card test jack TP1 and adjust selector module card potentiometer R15 for a 0-volt ±20-millivolt indication.

j. Using a DC voltmeter, monitor selector module card test jack TP2 and adjust selector module card potentiometer R20 for a 0-volt ±20-millivolt indication.

k. Reconnect the PSK carrier input to the unit and observe that the LOSS LOCK indicator extinguishes.

l. Modulate the PSK carrier with an NRZ signal at a bit rate established as follows:

$$\frac{\text{Carrier Rate}}{\text{Bandpass Input Filter Bandwidth}} = \text{Cycles Per Bit}$$

The bit pattern should be an alternate 1010... pattern.

m. Using an oscilloscope, monitor the selector module card test jack TP3 and adjust selector module card potentiometer R34 for a symmetrical square-wave pattern.

n. After completing the procedure, check the capture and tracking range of the unit by changing the PSK input frequency to the upper and lower limits of the unit. At the upper and lower frequencies, remove and reconnect the PSK input several times to ascertain the unit will lock on the deviated input. If the unit will not lock at the upper frequency, repeat this procedure from step (e) to the end, except offset the adjustment in step (f) more positive.

D.7 DRAWINGS

The drawings illustrating the PSK Selector Module are shown in Figures D-2 through D-5. These drawings illustrate the Model 2727-10 PSK Selector Module only. For drawings pertinent to the Model 2726-02 PCM Signal Conditioner chassis, refer to Section 5 of the associated instruction manual. One exception to this is the detailed block/wiring diagram shown in Figure D-5. Basically, these drawings are the same as in the associated instruction manual except for the circuitry contained in the PSK Selector Module.

D.8 PARTS LIST

The parts list for the PSK Selector Module is contained in Table D-1. Parts lists for the Model 2726-02 PCM Signal Conditioner chassis are provided in Tables 6-1 through 6-4 of the associated instruction manual. Manufacturers' code numbers are used to identify the original manufacturers of the unit components. These code numbers are provided in the MFGR. column of Table D-1. A complete list of the code numbers and the corresponding manufacturers is contained in Table D-2.

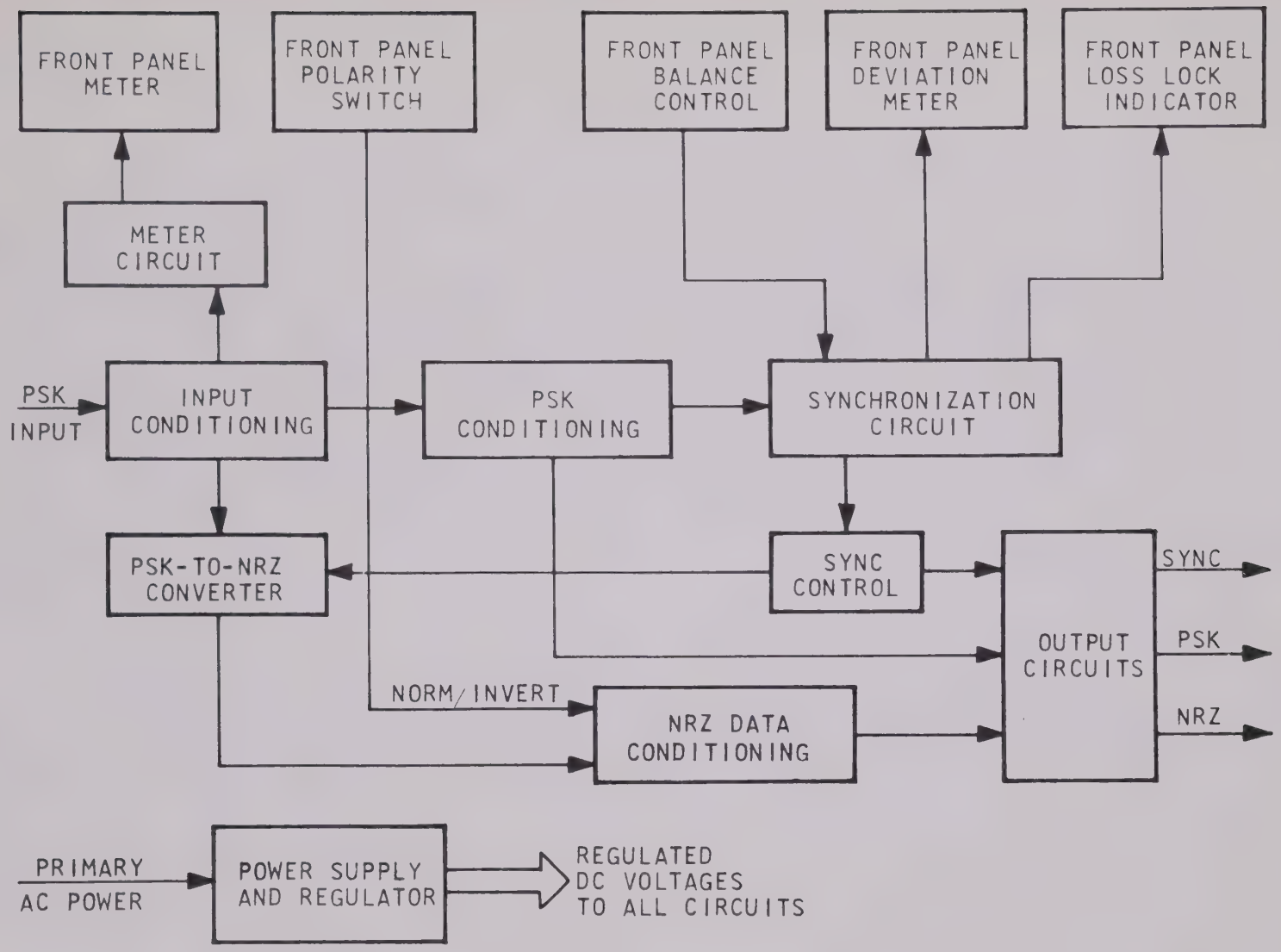
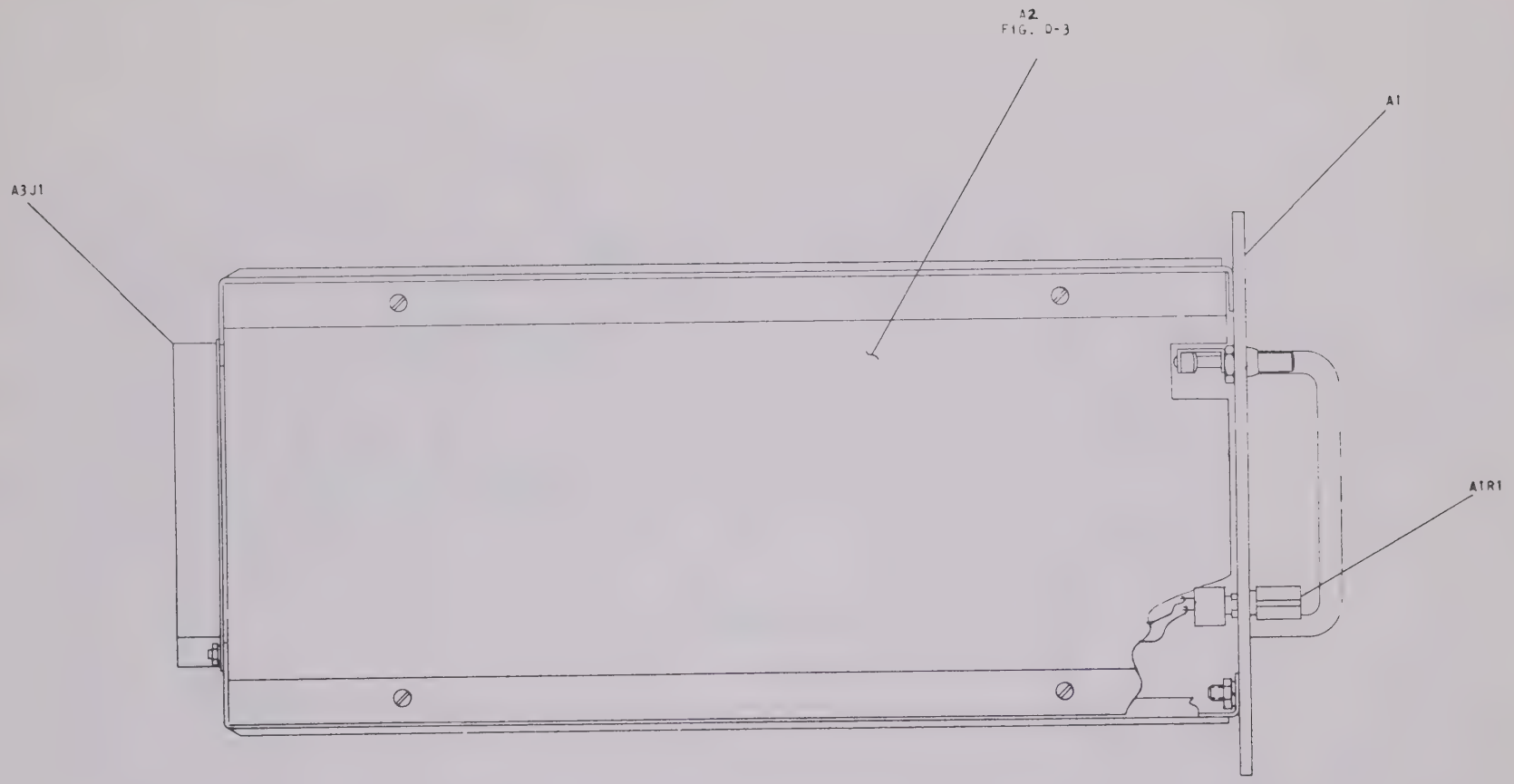


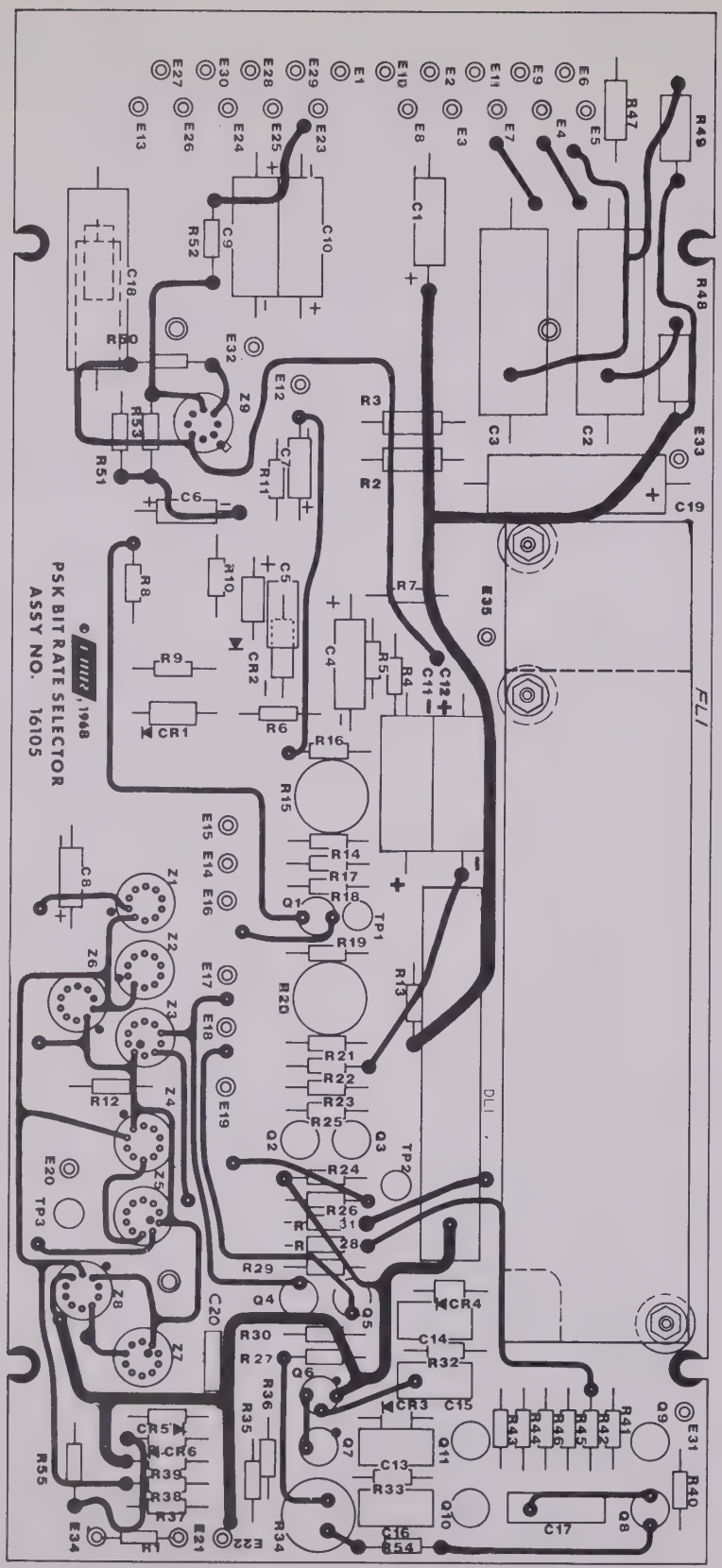
Figure D-1. PSK Demodulator Block Diagram



NOTE:

1. EMR DRAWING CONTROL NO. 2726-009.

Figure D-2. Model 2727-10 PSK Selector Module Assembly Diagram



Dwg. 16105, Rev. J

Figure D-3. PSK Selector Module Card A2
Assembly Diagram

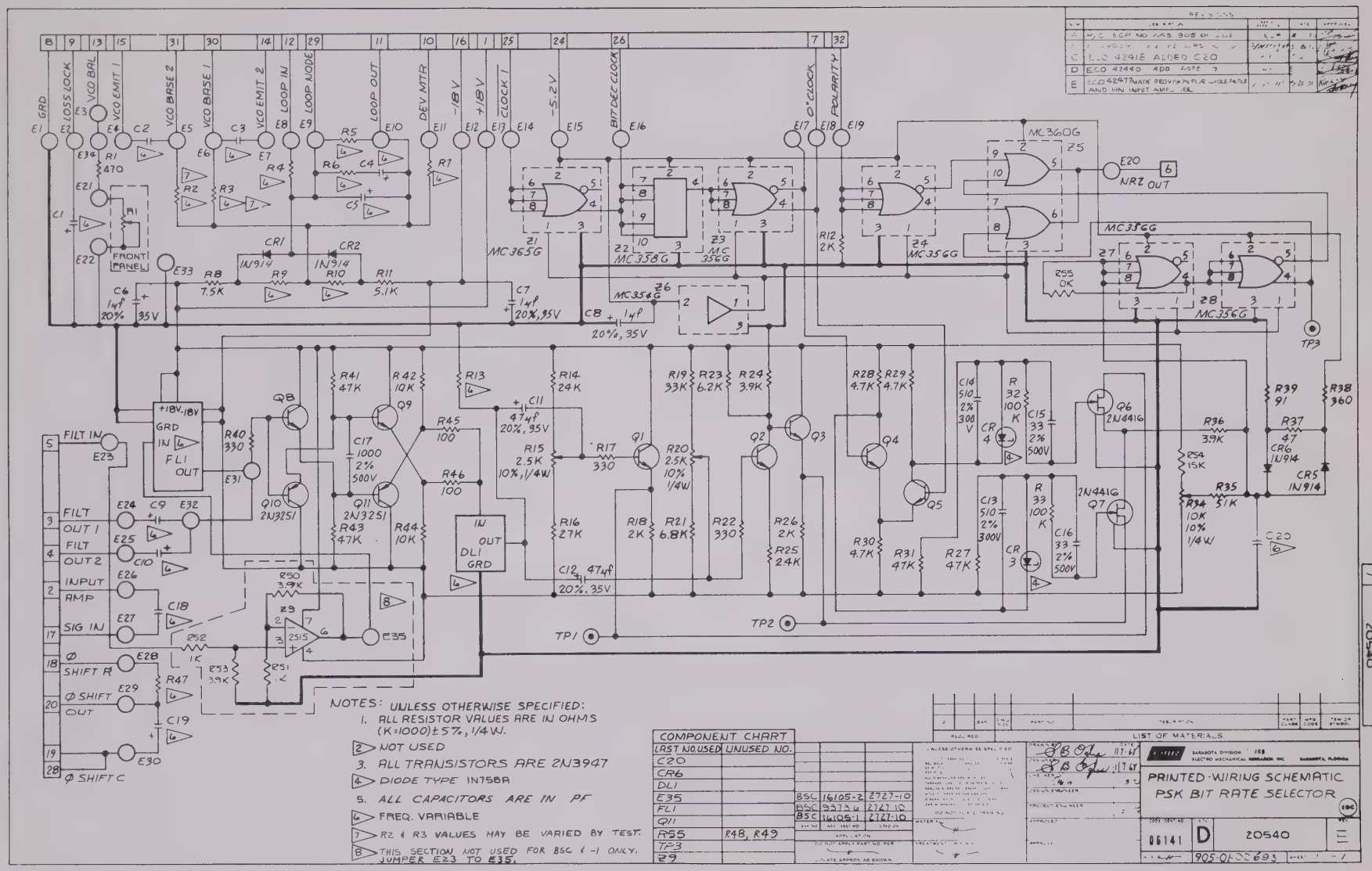


Figure D-4. PSK Selector Module Schematic Diagram

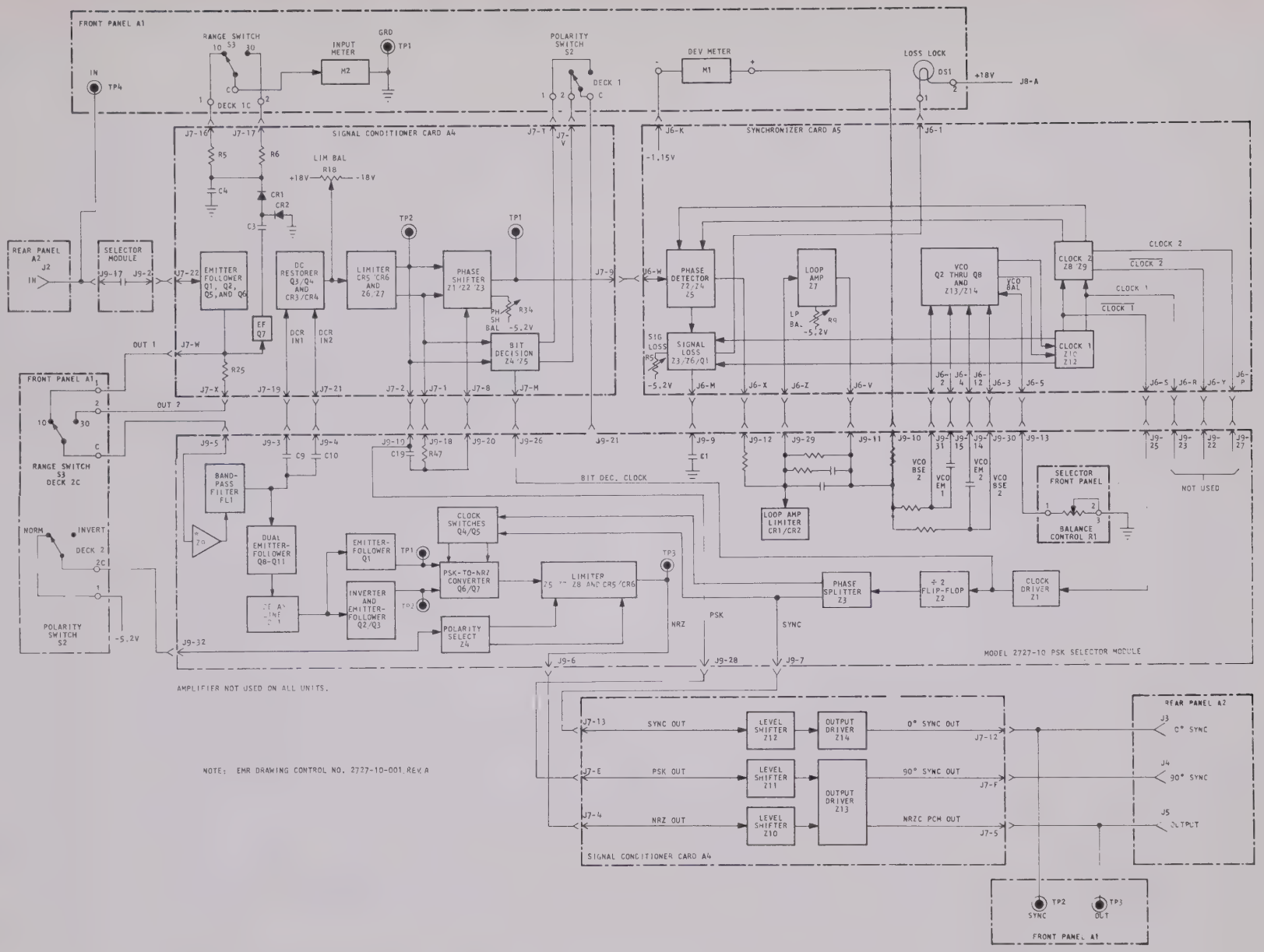


Figure D-5. PSK Demodulator Detailed Block Diagram and Wiring Diagram

Table D-1. PSK Selector Module Parts List (Ref. Figures D-2 and D-3)

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
	MODEL 2727-10 PSK SELECTOR MODULE	414-89-00052	06141	9373-6	1		
A1R1	RESISTOR, Var., 500 Ohms ±10%, 1/2W	636-01-50009	06141	819	1		
A2	PRINTED-WIRING ASSEMBLY, PSK Bit Rate Selector	205-89-00966	06141	16105-1 (Rev. F)	1		
C1 thru C5	CAPACITOR (Frequency Variable)		06141	20701			
C6 thru C8	CAPACITOR, 1.0 μF ±10%, 35V	336-14-10003	06141	601	3	1	
C9 & C10	CAPACITOR (Frequency Variable)		06141	20701			
C11 & C12	CAPACITOR, 47 μF ±10%, 35V	339-14-47004	06141	601	2	1	
C13 & C14	CAPACITOR, 510 pF ±1%, 500V	304-20-51009	06141	600	2		
C15 & C16	CAPACITOR, 33 pF ±.5 pF, 500V	304-08-03309	06141	600	2	1	
C17	CAPACITOR, 1000 pF ±2%, Non-Std.	305-19-10000	06141	600	1		
C18 thru C20	CAPACITOR (Frequency Variable)		06141	20701			
CR1 & CR2	DIODE, Switch, 75V, TRR	088-10-09140	JEDEC	1N914	2	1	
CR3 & CR4	DIODE, 1N758A Zener, 10.0V	088-99-00259	06141	642-12	2		
CR5 & CR6	Same as CR1						
DL1	DELAY LINE (Frequency Variable)		06141	20701			
FL1	BANDPASS INPUT FILTER (Freq. Var.)		06141	20701			
Q1 thru Q5	TRANSISTOR, NPN, 40V, Sw-Ampl., HFE	263-10-39470	JEDEC	2N3947	7	2	
Q6 & Q7	TRANSISTOR, FET N CHAN, 30V, VHF	263-10-44160	JEDEC	2N4416	2	1	
Q8 & Q9	Same as Q1						
Q10 & Q11	TRANSISTOR, PNP, Sw-Ampl., 50V	263-10-32510	JEDEC	2N3251	2	1	
R1	RESISTOR, 470Ω ±5%, 1/4W	616-02-47009	01121	RC07GF471J	1		
R2 thru R7	RESISTOR (Frequency Variable)		06141	20701			
R8	RESISTOR, 7.5K ±5%, 1/4W	616-02-75000	01121	RC07GF752J	1		
R9 & R10	RESISTOR (Frequency Variable)		06141	20701			

Table D-1 (Cont'd.). PSK Selector Module Parts List (Ref. Figures D-2 and D-3)

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
R11	RESISTOR, 5.1K ±5%, 1/4W	616-02-51000	01121	RC07GF512J	1		
R12	RESISTOR, 2K ±5%, 1/4W	616-02-20000	01121	RC07GF202J	3		
R13	RESISTOR (Frequency Variable)		06141	20701			
R14	RESISTOR, 24K ±5%, 1/4W	616-02-24001	01121	RC07GF243J	1		
R15	POTENTIOMETER, 2.5K ±20%, 1/4W, 1 Turn	201-98-00070	12697	63M5	2	1	
R16	RESISTOR, 27K ±5%, 1/4W	616-02-27001	01121	RC07GF273J	1		
R17	RESISTOR, 330Ω ±5%, 1/4W	616-02-33009	01121	RC07GF331J	3		
R18	Same as R12						
R19	RESISTOR, 33K ±5%, 1/4W	616-02-33001	01121	RC07GF333J	1		
R20	Same as R15						
R21	RESISTOR, 6.8K ±5%, 1/4W	616-02-68000	01121	RC07GF682J	1		
R22	Same as R17						
R23	RESISTOR, 6.2K ±5%, 1/4W	616-02-62000	01121	RC07GF622J	1		
R24	RESISTOR, 3.9K ±5%, 1/4W	616-02-39000	01121	RC07GF392J	2		
R25	RESISTOR, 2.4K ±5%, 1/4W	616-02-24000	01121	RC07GF242J	1		
R26	Same as R12						
R27	RESISTOR, 47K ±5%, 1/4W	616-02-47001	01121	RC07GF473J	5		
R28 thru R30	RESISTOR, 4.7K ±5%, 1/4W	616-02-47000	01121	RC07GF472J	3		
R31	Same as R27						
R32 & R33	RESISTOR, 100K ±5%, 1/4W	616-02-10002	01121	RC07GF104J	2		
R34	POTENTIOMETER, 10K ±20%, 1/4W, 1 Turn	201-98-00031	12697	63M5	1	1	
R35	RESISTOR, 51K ±5%, 1/4W	616-02-51001	01121	RC07GF513J	1		
R36	Same as R24						
R37	RESISTOR, 47Ω ±5%, 1/4W	616-02-04709	01121	RC07GF470J	1		
R38	RESISTOR, 360Ω ±5%, 1/4W	616-02-36009	01121	RC07GF361J	1		
R39	RESISTOR, 91Ω ±5%, 1/4W	616-02-09109	01121	RC07GF910J	1		
R40	Same as R17						
R41	Same as R27						
R42	RESISTOR, 10K ±5%, 1/4W	616-02-10001	01121	RC07GF103J	3		
R43	Same as R27						

Table D-1 (Cont'd.). PSK Selector Module Parts List (Ref. Figures D-2 and D-3)

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
R44	Same as R42						
R45 & R46	RESISTOR, 100Ω ±5%, 1/4W	616-02-10009	01121	RC07GF101J	2		
R47	RESISTOR, 1K ±1%, 1/8W	605-09-10000	06141	625	1		
R54	RESISTOR, 15K ±5%, 1/4W	616-02-15001	01121	RC07GF153J	1		
R55	Same as R42						
TP1 thru TP3	JACK, Test, Black	143-98-00010	74970	105-853	3		
Z1	INTEGRATED CIRCUIT, Line Driver, 50Ω	046-16-00011	04713	MC365G	1	1	
Z2	INTEGRATED CIRCUIT, AC Coupled J-K F/F	046-16-00002	04713	MC358G/ SC1322A	1	1	
Z3 & Z4	INTEGRATED CIRCUIT, 3-Input POS NOR	046-16-00001	04713	MC356G	4	1	
Z5	INTEGRATED CIRCUIT, Dual 2-Input, NOR	046-16-00003	04713	MC360G	1	1	
Z6	INTEGRATED CIRCUIT, Bias Driver	046-16-00005	04713	MC354G	1	1	
Z7 & Z8	Same as Z3						

EMR 2700

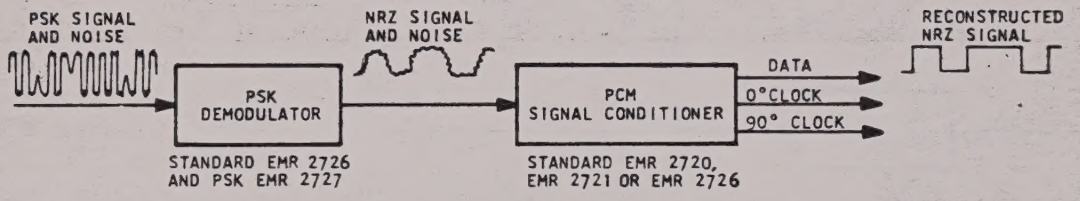
application notes

Question: Is this compatible with IRIG PCM code? Does demod transfer to

PSK DEMODULATION

Telemetry System Application

PSK telemetry inputs can be handled by the EMR Model 2726 Signal Conditioner and a specially developed Model 2727 plug-in PSK Carrier Selector. The equipment can be used for demodulation of both coherent and noncoherent ±90° PSK'ed carriers. Typically, the Model 2726 accepts a PSK signal which has been corrupted with noise, baseline shift, or frequency modulation introduced by the rf link or tape recorder, and translates the carrier to an NRZ PCM serial wavetrain. The EMR Model 2720, 2721, or another 2726 PCM Signal Conditioner is used to regenerate the NRZ PCM signal as well as develop bit-rate clocks for system timing. This signal conditioner is simply set to the NRZ bit rate and its filter selected for optimum extraction of the PCM signal from the noise environment.



TYPICAL SYSTEM APPLICATION OF
THE EMR MODEL 2726/2727 PSK DEMODULATOR

Operation of the PSK Demodulator

The EMR Model 2726 is basically a PCM Signal Conditioner that utilizes a plug-in module to select the parameters of the input signal. For use as a PSK demodulator, the EMR Model 2727 plug-in module selects the carrier frequency, tracking range, and loop filter width. It is not necessary to specify the PCM bit rate, the PCM-to-carrier coherence, or whether the carrier is differentially modulated in the selection of this plug-in module. The PSK signal is demodulated with a linear translation technique that preserves the input signal-to-noise ratio and permits filtering with the low pass input filter of the associated PCM signal conditioner.

2721 bit synchronizer handles 10 bit/sec to 1 megabit/sec, all codes